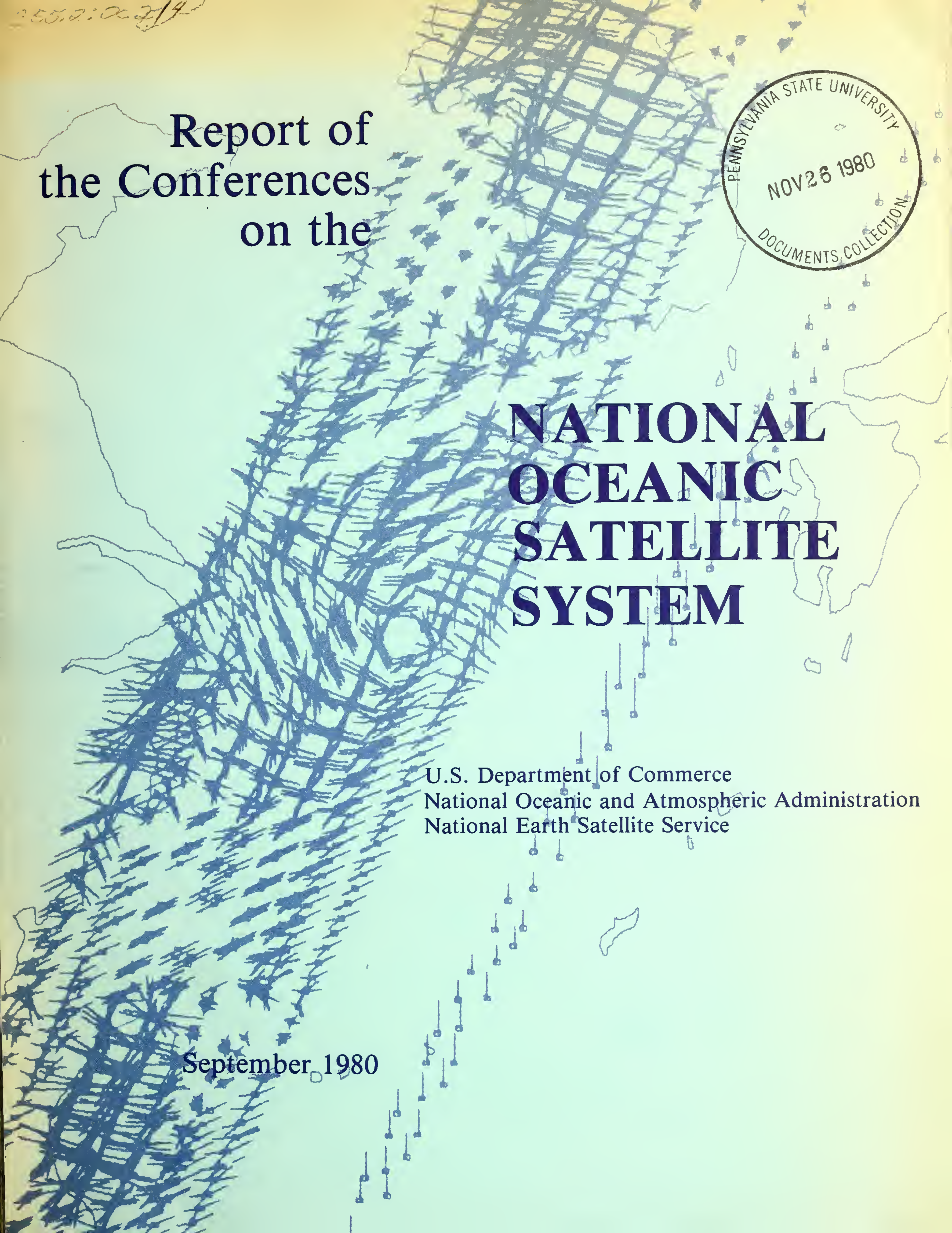
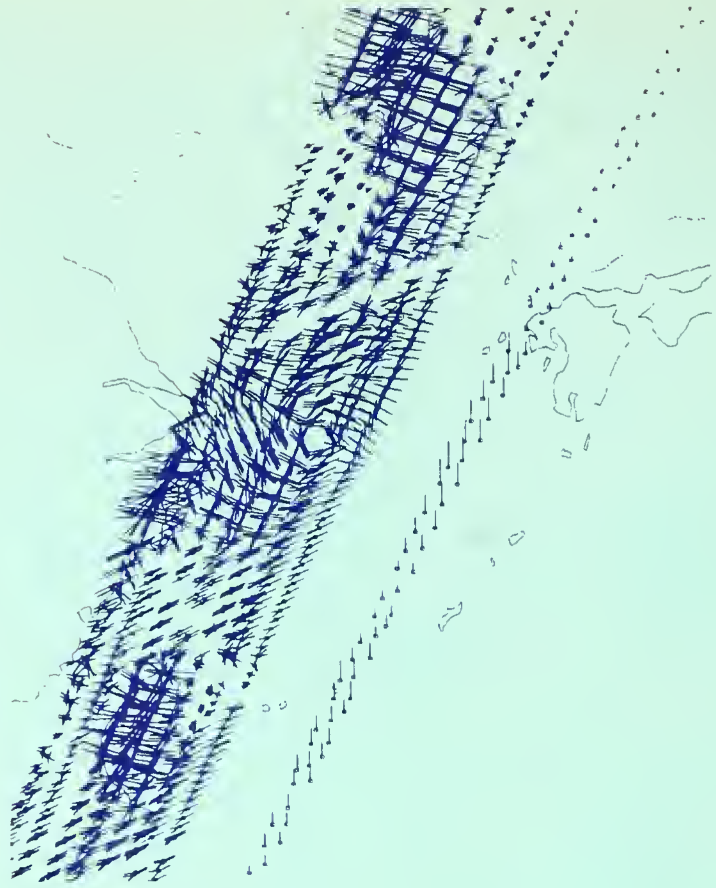


Report of the Conferences on the NATIONAL OCEANIC SATELLITE SYSTEM

U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Earth Satellite Service

September 1980



Cover Description

Seasat scatterometer coverage of typhoon Wendy over the East China Sea on July 30, 1978, 1056 (GMT). Maximum winds recorded were 35 m/s. This illustration shows all possible wind vector solutions (up to four) wherein vector length is proportional to wind magnitude and the wind direction given by the vector direction. This product is representative of surface wind products potentially achievable from NOSS.

Illustration courtesy of the NASA Jet Propulsion Laboratory Seasat Project and Dr. Peter Black of NOAA's National Hurricane and Experimental Meteorology Laboratory.

REPORT OF THE CONFERENCES

ON THE

NATIONAL OCEANIC SATELLITE SYSTEM

Report Prepared By

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NOAA/NESS/SPOC Group
S/RE x 3, Room 810, WWB
Washington, D.C. 20233

Conferences Managed By

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Washington, D.C. 20007

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL EARTH SATELLITE SERVICE

SEPTEMBER 1980

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Washington, D.C. 20402

PREFACE

All the rivers run into the sea; yet the sea is not full; unto the place from whence the rivers come, thither they run again.

Ecclesiastes

Ancient wisdom included fundamental concepts on the nature of the cycles of the Earth's hydrosphere. Well before the introduction of coriolis forces, this same wisdom understood "the wind goeth toward the south, and turneth about unto the north; it whirleth about continually, and the wind returneth again according to his circuits." Only in more recent times are concepts forthcoming that define the dynamics of this hydrosphere.

Modern science has demonstrated through such satellite systems as SKYLAB, GEOS-3, Seasat and Nimbus-7 that both initial conditions and changes in the hydrosphere can be observed. In particular the oceanic and ice planetary layer characteristics can be quantified. Global assimilation of these measurements, tied with improved computing machines and modern communication techniques, can benefit the ever increasing coastal population, the seafarer, the climatologist, the ship router, the geophysicist, the fisherman, the meteorologist, the recreational boater, the oceanologist, and all who need improved weather forecasts.

Plans are being evaluated within the Federal Government of the United States for a National Oceanic Satellite System, a system designed to monitor the hydrosphere, to observe "the place from whence the rivers come, thither they run again."

ACKNOWLEDGEMENTS

The five regional Conferences on the National Oceanic Satellite System involved more than 400 participants who shared in the success of these Conferences and the first steps in determining the nature and scope of the needs and requirements for oceanic data to be derived from this proposed satellite program.

To all participants, moderators, presenters and chairs, we extend a sincere "thank you".

Special acknowledgement is given to: Arthur G. DeCotiis (NESS) for his early help in organizing and support during the Conferences, Robert L. Mairs (NESS) and Linda K. Glover (NWS) for preparation of the report description of NOAA's oceanic satellite products, and Madelyn Y. Bowman (NESS) for her dedicated and patient typing of the first two drafts of the report.

The efficient, timely and professional support provided to the Conferences and the final report preparation by Human Resources Management, Inc., is acknowledged with great appreciation. Rhoda R. Habib of HRM deserves warm praise for her outstanding assistance to the success of this endeavor.

W. John Hussey
Deputy NOSS Program Manager

John W. Sherman, III
Conference Coordinator

OVERVIEW OF CONFERENCES

Approximately 400 persons participated in five Conferences on the potential National Oceanic Satellite System (NOSS). These Conferences were sponsored by the National Oceanic and Atmospheric Administration (NOAA) of the Department of Commerce in fulfillment of its responsibilities to represent the civil marine community in National programs.

These five Conferences were held in:

Seattle, Washington	May 19, 1980
La Jolla, California	May 22, 1980
Woods Hole, Massachusetts	May 28, 1980
Key Biscayne, Florida	June 3, 1980
Bay St. Louis, Mississippi	June 5, 1980

Each Conference followed a morning format devoted to NOAA's oceanic space activities. and an afternoon format focused on marine user requirements and the manner in which satellite-derived data and information would address these user needs.

The purpose of this report is to document the presentations and discussions at the Conferences and to present the initial analyses of the Conference Worksheets completed by 144 marine operational and research users. The report includes the points raised by these users and presents a series of findings and concerns. These findings and concerns are not necessarily the findings and concerns of the tri-agency NOSS Program sponsored jointly by the Navy, NASA and NOAA, nor any other government agency. The report is published to enhance and continue the dialogue between NOAA and the civil marine community that it represents.

Seven major points were common to each of the Conference discussions:

1. Major support exists in the oceanic community for the NOSS concept as a means of addressing marine needs. This support is moderated by the experience of many of these users who wish to have data from existing experimental satellites. This experience has shown that extended lengths of time are required for the data to be obtained in useful formats.

2. This waiting experience creates a credibility problem for the proposed NOSS system delivery times of a few hours. Users would like improved delivery times from other satellites to demonstrate that it can be done.

3. Validation of the NOSS data and information is held essential by users who strongly encourage development of a validation plan. The users believe that the validation plan requires inclusion of actual marine users and therefore, representative user programs should be included.

The Conference participants believe that the success of NOSS will be judged best by those whom NOSS will serve and not by those who serve NOSS.

4. The users endorse the Conference approach as a means of continuing communication between the NOSS program and the marine community. Other suggestions include an advisory committee, newsletters or bulletins, trade and professional journal publications on state-of-the-art techniques and development, and audio/visual cassettes. Users in the commercial sector wish to serve in a senior advisory capacity to NOAA on NOSS matters, and the R&D community also feels it has an advisory role to both NASA and NOAA.

5. Discussions of data availability include considerations of vessel-at-sea needs, protected retrospective use, compatibility with other data sets, and data source(s) for all forms of oceanic data. NOSS will not have the most rudimentary form of data availability found on previous environmental satellites (i.e., Automatic Picture Transmission capability); they believe such availability is essential to NOSS data use. It is suggested that NOSS planners take an additional step to include the near-real time wind, wave, temperature, ice, and water mass information needs of at-sea users as a key component of the NOSS activity.

Users understand the need for protected data (i.e., data withheld for reasons of national security), but would like retrospective use. Additionally, the users believe that NOSS data must be fully compatible with other data, particularly data from other satellites.

Currently, different marine information is available from different components of NOAA. Users anticipate that a major success for the NOSS program may not lie in the success of the National Oceanic Satellite System, but in the creation of a national oceanic data system, which includes data and information derived from satellites and other observing platforms such as ships and buoys.

6. Some oceanic data users believe that a commitment is needed beyond the planned five-year demonstration if investments are to be made by the marine community to use NOSS data operationally.

7. Training in oceanic remote sensing for day-to-day use of NOSS-derived data is of concern to users. In addition, research and development users suggest that a national facility is needed to assimilate, process and analyze NOSS data, including the 25% R&D growth capacity for other oceanic experimentation. Oceanic researchers want to do scientific investigations and not computer studies.

The findings and concerns of users, as expressed in the initial analyses of the Conference Worksheets, are generally more specific than the points of commonality cited above. Data and data telemetry, processing and training, dialogue and communications mechanisms, validation, and support to research and development are the main categories of findings and concerns of the Conferences.

No summary or conclusions of the Conferences have been prepared beyond this overview. The Report itself is regarded as an element in the continuing dialogue between NOSS planners and NOSS users, and this dialogue has not been concluded.

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I. INTRODUCTION

1. Purpose, Scope and Objectives of Conferences

The need for frequent and accurate measurements of the marine environment has increased dramatically during the past decade. Accurate analysis and prediction of oceanic and coastal conditions are essential for supporting rapidly increasing maritime activities. The National Oceanic and Atmospheric Administration (NOAA) of the Department of Commerce (DOC) recognizes these new requirements for marine data, and is responding through the expansion of existing oceanic services programs and through participation in new programs such as the National Oceanic Satellite System (NOSS) operational demonstration. NOSS is a tri-agency activity supported jointly by the Department of Defense (DOD), National Aeronautics and Space Administration (NASA) and DOC. NOAA has the lead responsibility for services to civil marine users.

NASA research and development spacecraft programs (e.g., Nimbus-7, Seasat) have shown that satellite observations can play an important role in providing data for both the operational analysis of, and research on, oceanic conditions. Building upon these NASA programs, NOSS has been proposed as a limited operational demonstration to test the feasibility of obtaining measurements of surface wind velocity, sea surface temperature, significant waveheight, sea ice conditions, chlorophyll and other optical characteristics, and current measurements from a polar-orbiting satellite. NOAA operational satellite systems now provide sea surface temperature and sea ice data, but only under cloud-free conditions. Because of the ability of microwave sensors to effect surface observations during cloudy conditions, NOSS microwave data are expected to improve significantly the efficiency, safety and effectiveness of marine transportation, off-shore exploration and extraction, platform operations, construction, commercial fishing and scientific knowledge of ocean surface dynamics.

The NOSS operational demonstration is planned as a five-year program beginning with the launch of the first spacecraft in mid-1986. The four basic sensors that will provide the specified oceanic data are a scatterometer, a microwave radiometer, a microwave altimeter, and an ocean color scanner. Other oceanic research and development sensors may be flown on this system as part of NASA's continuing space research program.

Five one-day Conferences were held in May-June, 1980, to inform marine users of the proposed NOSS tri-agency program. The specific objectives of these Conferences were to:

- o Present the status of NOAA's new space mission and NOSS technology and development;
- o Provide a description and status of the tri-agency NOSS program;
- o Obtain comment on user priorities and requirements for NOSS data; and
- o Develop methods by which the marine community can influence the NOSS data system configuration.

2. Report Organization

This report is organized to reflect an overview of the presentations to the Conference participants, the response of the participants to the NOSS marine data goals and the initial analyses of these responses. Specifically, Chapter II defines NOAA's new civil space mission and its relationship to NOSS, NOAA's present-day satellite-derived marine products and the experience derived by the oceanic community from using NASA's research satellites. Chapter III is a summary of the NOSS tri-agency program, including a brief review of program management, sensor descriptions and responsibilities of the three agencies.

Chapter IV, Review of Conferences, delineates the real purpose of these Conferences; i.e., to obtain early involvement of potential NOSS data users to define the data products and distribution system. This chapter briefly discusses the organization of the Conferences, then defines the types of participants and their marine data needs as determined from both the topical group meetings and the Conference Worksheets. The initial analyses of these marine data needs form

what may be the most interesting element of the report. Chapter IV concludes with a summary of these initial analyses in terms of a series of findings and concerns. Chapter V briefly discusses the methods by which communications between NOSS designers and the oceanic community can be continued.

Supporting the Conference Report are appendices which contain information on the Conference attendees, the Conference Worksheets and statistical summary of these Worksheets, a summary transcript of the closing discussions by participants, specific limitations of the frequency of coverage of polar-orbiting satellites, descriptions of the NOSS heritage sensors flown on Seasat and Nimbus-7, and the NOSS baseline sensor descriptions. Closing the appendices are a glossary of acronyms used in the report and a selected bibliography of recent technical publications which provide details on spacecraft oceanology.

3. Limitation

It is emphasized that this report documents the events which occurred during the Conferences and summarizes the findings and concerns of the participants. These findings and concerns are not necessarily the findings and concerns of the tri-agency NOSS Program, NASA, DOD/Navy, DOC/NOAA nor any other government agency. The report is published to enhance and continue the dialogue between NOAA and the civil marine community that it represents and serves.

II. BACKGROUND

1. NOAA's New Civil Space Mission

Last November. the President of the United States designated NOAA as the single agency to manage the Nation's civil operational land remote sensing activities from space in addition to its ongoing atmospheric and oceanic satellite responsibilities (Presidential Directive NSC-54; Nov. 16, 1979). NOAA's credentials in the field of atmospheric and oceanic sciences and services are well established. For the better part of two decades, NOAA has been routinely managing and operating environmental satellite systems and providing data and products from those systems to users worldwide. In naming NOAA as the civil space program manager for operational land systems, this past performance was certainly noted and NOAA accepted willingly the Presidential decision. With the addition of operational land satellite programs NOAA is now the lead agency for operational, civil, earth satellites.

NOAA currently operates two environmental satellite systems· one system (two satellites) in geo-stationary orbit and one system (two satellites) in polar sun-synchronous orbit. Data received from the complement of instruments aboard these spacecraft are used in the production of a host of meteorological and oceanographic products which are available to the civilian user community.

NOAA, as a part of its R&D mission, supports many satellite activities of NASA. This NASA-led research has paved the way for NOSS through a rich history of R&D satellite programs. Most noteworthy for the marine community are the 1978 launches of Seasat and Nimbus-7, whose oceanic sensors form the basic instrument package for NOSS. Indeed, with the exception of the Seasat Synthetic Aperture Radar (SAR) System, NOSS combines the benefits of these two NASA satellites to permit the Navy, NASA and NOAA to conduct a limited operational demonstration beginning in the mid-1980's.

The key to NOAA's success in meeting the users' needs for NOSS data is an accurate definition of data requirements. This can only be achieved through close coordination with the marine community throughout the planning and implementation phases of the NOSS program. This close coordination will bring about a marine data system with the capability of meeting the civilian oceanic community's needs throughout the lifetime of the NOSS program and beyond. NOAA's success in its NOSS mission will be the result of full coordination with the efforts of the oceanic community.

2. NOAA's Existing Satellite Marine Products

Data from both the GOES[1] geostationary and the TIROS-N[2] polar-orbiting satellite systems are used to produce several of NOAA's existing operational marine products. These products are produced at the National Environmental Satellite Service[3] (NESS) central facilities, and at the Satellite Field Services Stations and National Weather Service Offices having oceanic support responsibilities.

The primary data sources for these products are GOES and TIROS-N infrared and visible data. These data are received at the data receiving locations from the NESS Command and Data Acquisition facilities at Wallops Island, Virginia, and Gilmore Creek, Alaska. They are also acquired directly from the polar orbiting satellites via direct readout, High Resolution Picture Transmission (HRPT) and Automatic Picture Transmission (APT).

Examples of Products

Global Operational Sea Surface Temperature Computation (GOSSTCOMP): Global sea surface temperature (SST) observations are obtained daily from the polar-orbiting satellite's Advanced Very High Resolution Radiometer (AVHRR). The model used to obtain these temperatures is a fully automated computer procedure. Surface temperatures are derived by a histogram technique applied to a matrix of instrument measurements in 50- and 100-km^2 areas. Corrections for atmospheric attenuation are computed and applied to the temperature retrievals. The model generates 30,000 to 40.000 time- and earth-located values of sea surface temperature daily. The derived observations are stored on computer disk for NOAA 360/195 terminal users, entered onto a magnetic tape for archive at the Environmental Data and Information Services' (EDIS) Satellite Data Services Division (SDSD), and used to produce an observation

transmission tape (when required) and a global analyzed field.

The global analyzed field is used to produce two types of products, photographic displays and gridded fields. The photographic displays enable the user to view the global SST pattern and the spatial distribution of observations used in the analysis. The gridded fields (Figure II-1) are contoured displays of sea surface temperatures in intervals of 1 degree C. They are available as Mercator projections from 70 degrees N to 70 degrees S latitude and in polar-stereographic projections for the remainder of the globe. The gridded fields are mailed to users once a week.

In December, 1978, NOAA's National Weather Service (NWS) also began producing synoptic, global sea surface temperature analyses. These analyses combine remote measurements made by satellites with direct sea surface temperature reports received from ships and data buoys. A two-step objective analysis is used. The first step is to establish a reliable "first guess" field; this is the sum of the present anomaly field (based upon data from the past 10 days) and the long-term average field. The second step is to correct the "first guess" field with recent observations. A percentage of each correction, depending on distance, is applied to each of the surrounding grid points. A numerical procedure known as "conditional relaxation" is used to spread the influence of the observations over the entire grid.

The global analyses are available from NWS by mail. Regional analyses are available for the Atlantic northwest (Figure II-2), the Pacific northeast, and the Gulf of Mexico, by mail and by the National Facsimile (NAFAX) Network. The SST data are used in numerical forecast models as support for other NOAA oceanic products and services, in development of climatology over ocean areas that are inaccessible using conventional observing methods, in various research activities and by commercial fisheries.

Great Lakes Surface Temperature Analysis: Analyses of the Great Lakes surface temperatures are produced as observed (whenever cloud free) using the data obtained from the polar-orbiting satellite's AVHRR. The data are computer-analyzed for each of the five Great Lakes, with a contour interval of 2 degrees C. The final product (Figure II-3) is then manually adjusted for accuracy and mailed to users.

The surface temperature analyses are useful in determining the rate of lake freeze and areas of upwelling. With this knowledge, plus observed weather and ice conditions, a forecast can be made for the routing of ships and for predicting the length of the shipping season. The Great Lakes surface temperature analysis is used by NWS, commercial marine transportation, Great Lakes research concerns and internally in NESS.

Great Lakes and Alaskan Ice Charts: The Great Lakes and Alaskan ice charts are detailed 1-km resolution analyses of the boundaries and type or age of ice observed from satellite imagery. The Great Lakes' freshwater ice is viewed, when cloud free, by the polar-orbiting satellite's AVHRR. A chart (Figure II-4) is prepared twice weekly and sent to users via the NAFAX Network and by mail. The chart defines the fast-ice and ice-free areas as well as the ice concentration and leads.

The Alaskan sea ice is also viewed, when cloud free, by the polar-orbiting satellite's AVHRR. A chart (Figure II-5) is prepared once a week and sent to users via NAFAX and by mail. The chart reveals the fast-ice and ice-free areas as well as the ice concentration, age and leads.

Both analyses are useful to NWS in its forecasting of ice conditions and ship routing. The Great Lakes ice chart is prepared at NWS' Weather Service Forecast Office (WSFO) at Ann Arbor, Michigan, and updated in the Navy/NOAA Joint Ice Center. The Alaskan ice chart is prepared at the Joint Ice Center in Suitland, Maryland. The ice charts are used by commercial marine transportation, the U.S. Navy and Coast Guard, the National Marine Fisheries Service and various research concerns.

Gulf Stream Analysis: The position and current direction of the Gulf Stream and its associated warm and cold eddies are helpful to a number of marine users. The commercial shipping industry can save fuel by steaming in the current

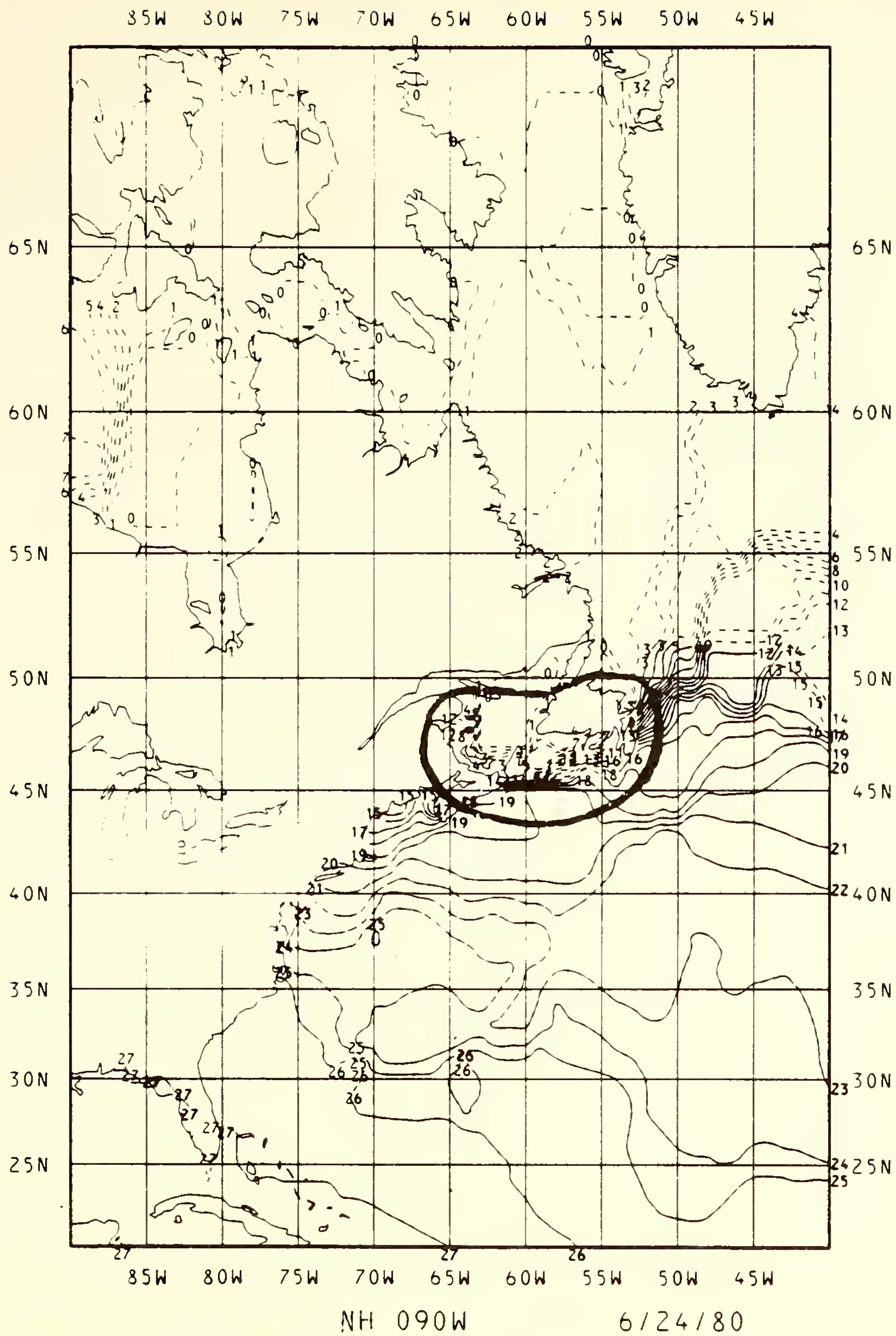

Figure II-1. GOSSTCOMP

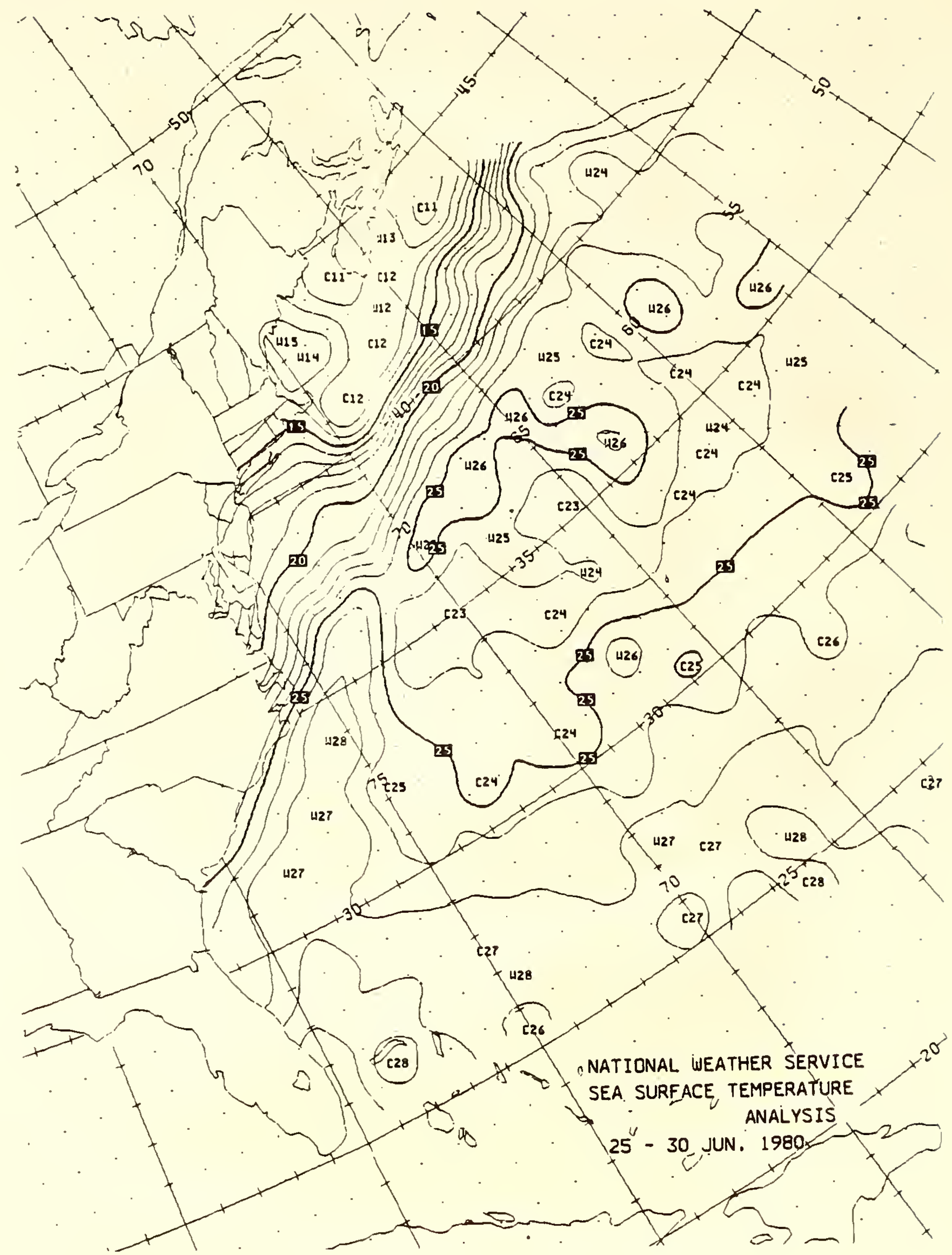

Figure II-2. Example of computer analysis combining sea surface temperatures from satellite, ships, and data buoys. Contours in 1°C.

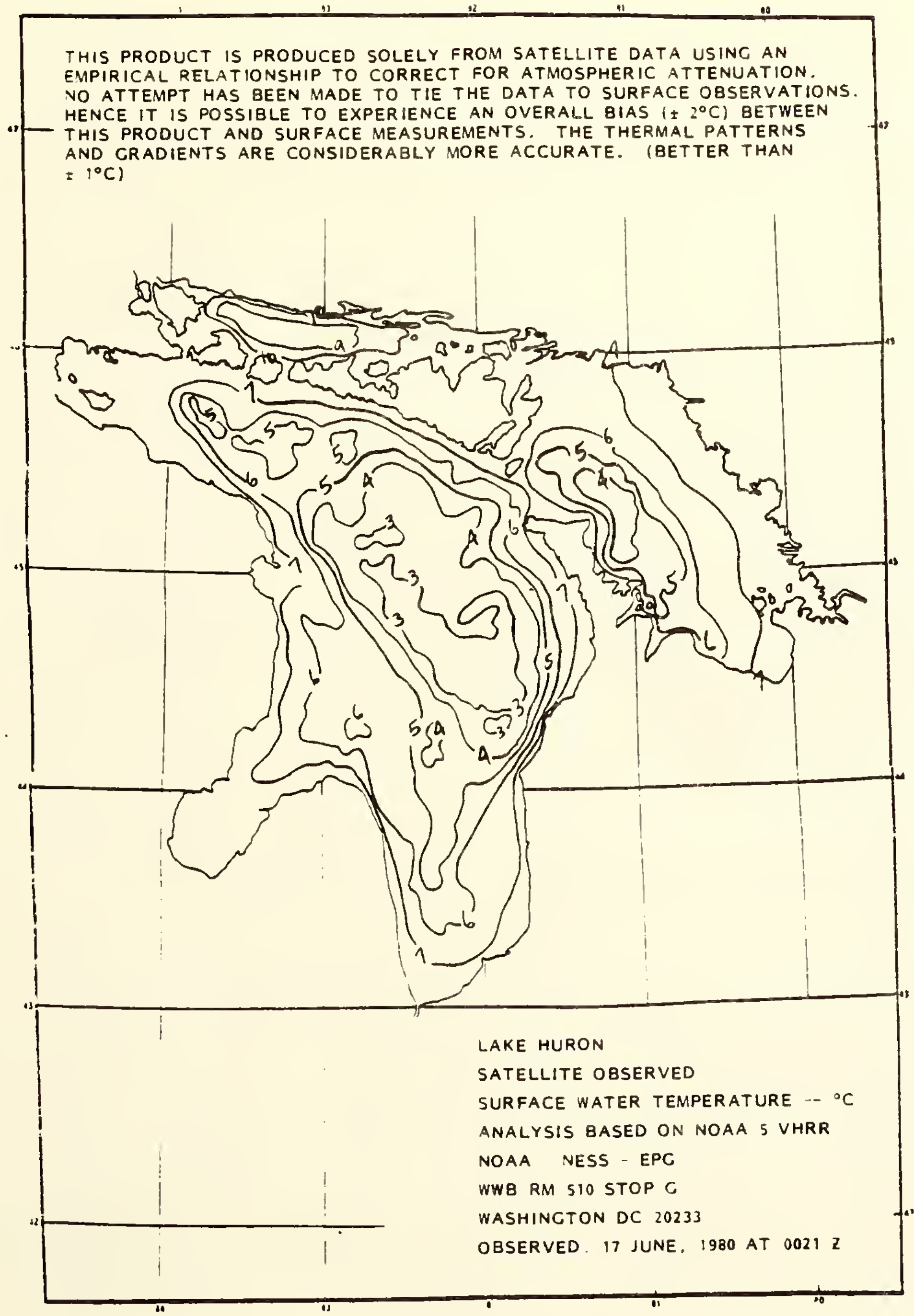

Figure II-3. Example of Great Lakes surface temperature analysis of Lake Huron. Contours in 1°C.

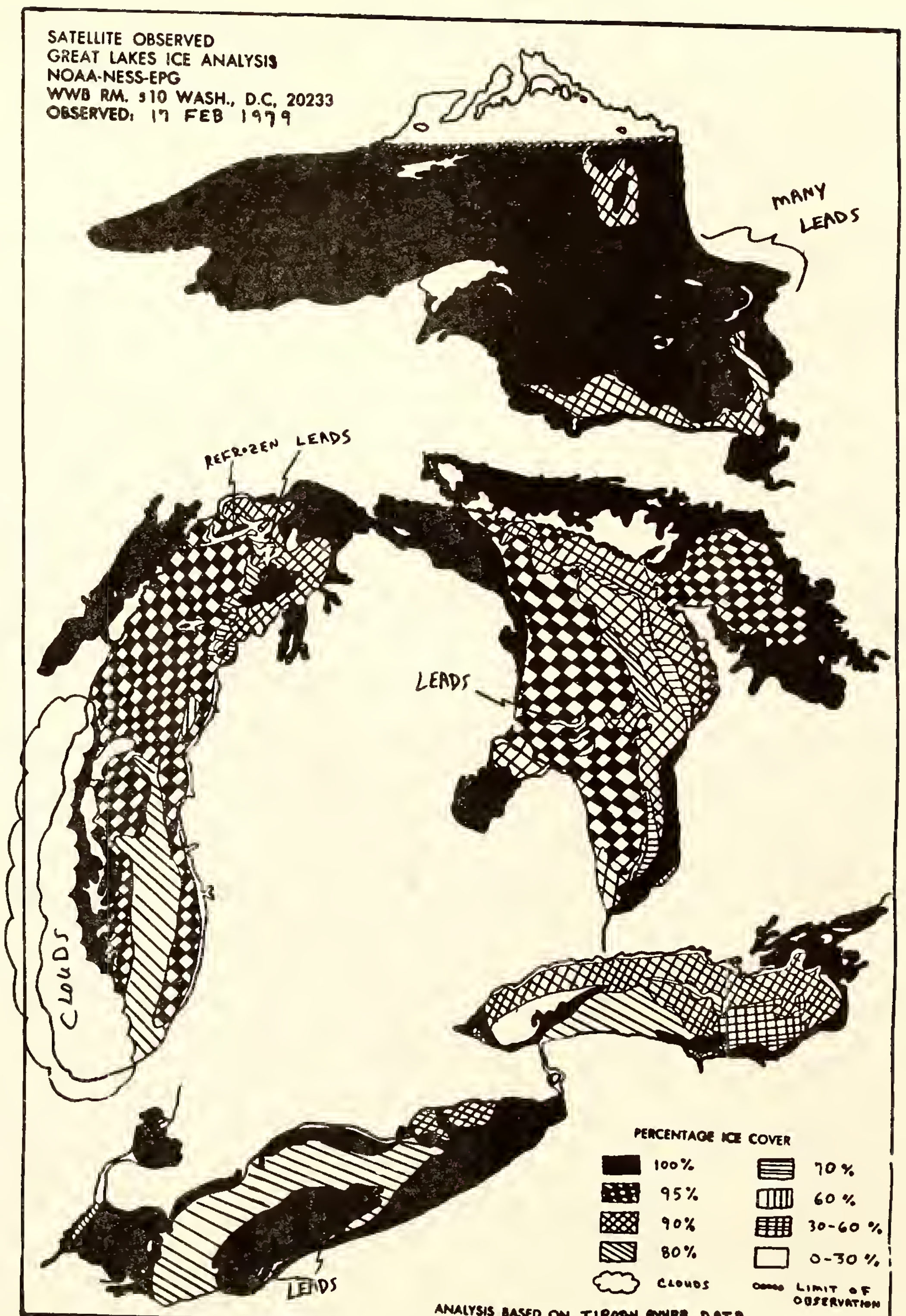

Figure II-4. Example of Great Lakes ice chart

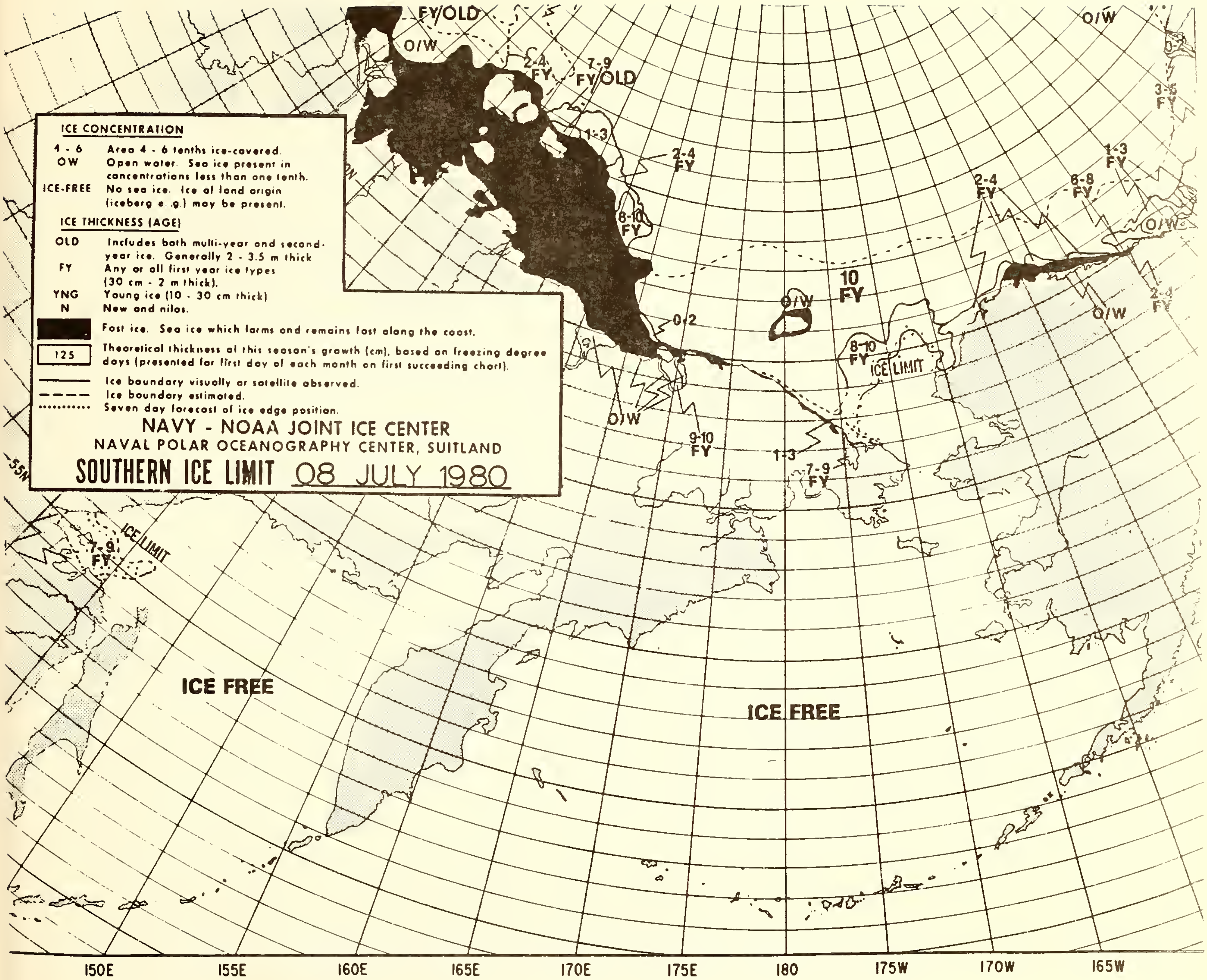

Figure II-5. Example of Alaskan ice chart

on northbound trips and avoiding it when traveling south along the coast. Commercial fishermen locate some species of fish near thermal boundaries like the Gulf Stream west wall or eddies which influence fish movement. The U.S. Coast Guard needs Gulf Stream flow information for search-and-rescue operations. Other users include recreational boaters and marine research activities.

The Gulf Stream Wall Bulletin (Figure II-6) informs the mariner of the position of the Gulf Stream's west wall; the fastest currents are usually found about 25 km seaward of this line. The position of the Gulf Stream Wall to 40 degrees N is analyzed three times a week, using geostationary satellite infrared imagery. Bulletins are broadcast twice daily by the U.S. Coast Guard.

In April, 1980, NOAA began issuing a handdrawn analysis, prepared jointly by NESS and NWS, of thermal features in the Gulf Stream region. Data used in the analysis include infrared imagery from polar-orbiting and geostationary satellites, sea surface temperature from ships and buoys, subsurface temperature from ships to check structure of surface features and seasonal sea ice analysis from the Joint Ice Center. The analysis is presented in two panels with the Gulf Stream area north of Cape Hatteras (Figure II-7), updated thrice weekly, and the Gulf of Mexico/Florida Straits area up to 35 degrees N, updated twice weekly. Features shown include position of the Gulf Stream and Loop Current; other major thermal fronts in the area (slope front, subtropical convergence); Gulf Stream and Loop Current eddies, with their size and flow direction; sea ice edge; and spot SST's. These charts are available weekly by mail and daily via NAFAX.

West Coast Thermal Front Analysis: The thermal front analysis of the waters off the west coast of the United States is used in locating areas of improved fishing for California fishermen. When upwelling occurs off the coast, the cold waters abound with nutrients, and along the boundaries between cold and warm waters the fish tend to gather to feed. Albacore tuna and salmon fishermen are the primary users of this kind of information.

Analyses are performed, cloud cover permitting, as often as possible using satellite infrared imagery from the AVHRR on TIROS-N and from the Visible Infrared Spin Scan Radiometer (VISSR) on GOES. The thermal fronts are drawn on a gridded chart (Figure II-8) and sent out via telecopier to locations along the California coast. The normal areas covered are from 50 degrees N to 30 degrees N latitude, 4 degrees off the coast of California, but other areas are available upon request. A plastic overlay showing navigation lines and bathymetric contours is available also on request.

NWS' Seattle Ocean Services Unit (SOSU) produces a west coast oceanographic analyis (Figure II-9). It combines ocean thermal fronts identified from satellite infrared imagery with sea surface temperature contours from ship and data buoy observations. The SOSU chart includes Loran-C navigation lines to aid fishermen in locating the thermal fronts.

3. Current Sources for Satellite-Derived Oceanic Products

Near-Real Time Data Services

The above listed samples of oceanographic products, derived wholly or in part from operational satellites, have been developed over the past decade by NESS and NWS and are presently produced at regionally located field sites in Anchorage, AK; Seattle, WA; San Francisco, CA; Miami, FL; and Washington, DC. For more information on what may be available by region, please contact either:

Mr. Bertrand J. Thompson NOAA/NWS Gramax Bldg., Rm. 1213 Silver Spring, MD 20910	or	Mr. Robert L. Mairs NOAA/NESS WWB, Rm. 607 Washington, DC 20233

Non-Real Time Data Services

The Environmental Data and Information Service (EDIS) of NOAA is the first Federal organization created specifically to manage environmental data and information. EDIS acquires, processes, archives, analyzes and disseminates world-

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    PTIUZYUW RUEOLMAØØ21 1891855↑UUUU↑↑RUCLFOA RULYWCA RUCLFLA
RUEBBRA RUCBNAF.
ZNR UUUUU
P Ø71855Z JUL 8Ø
FM NATIONAL ENVIRONMENTAL SATELLITE SERVICE
TO RUCLFOA/CGRADSTA MIAMI CCGD7
RULYWCA/CGCOMMSTA PORTSMOUTH
RUCLFLA/NAVOCEANO BAY ST LOUIS MISS
RUEBBRA/PATRON FOUR NINE
RUCBNAF/NAVFAC LEWES DE
BT
UNCLAS
GULF STREAM LOCATION.THE LINE DESCRIBED BY THE FOLLOWING
SEQUENCE OF POINTS REPRESENTS THE WEST WALL OF THE GULF STREAM.

27.Ø/8Ø.Ø          29.Ø/8Ø.Ø          31.5/79.5
32.2/78.8          34.3/76.Ø          35.Ø/74.7
36.6/73.Ø          37.5/71.4          37.8/7Ø.8
37.6/69.3          38.3/68.6          38.4/67.6
38.6/65.5          37.6/63.1

THE MAXIMUM CURRENT OF THE GULF STREAM LIES BETWEEN 12↑15 MILES
SEAWARD OF THIS LINE.
COLD EDDIES 34.Ø/72.9/9Ø NMI. DIAM
WARM EDDIES 39.Ø/71.5/9Ø NMI. DIAM 41.4/62.5/8Ø NMI. DIAM
LATEST SATELLITE DATE 7/7/8Ø 12ØØZ
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Figure II-6. Example of Gulf Stream Wall Bulletin. Positions coded as follows: 31.5/79.5 means 31.5°N 79.5°W. Location and size of cold and warm Gulf Stream eddies are also given.

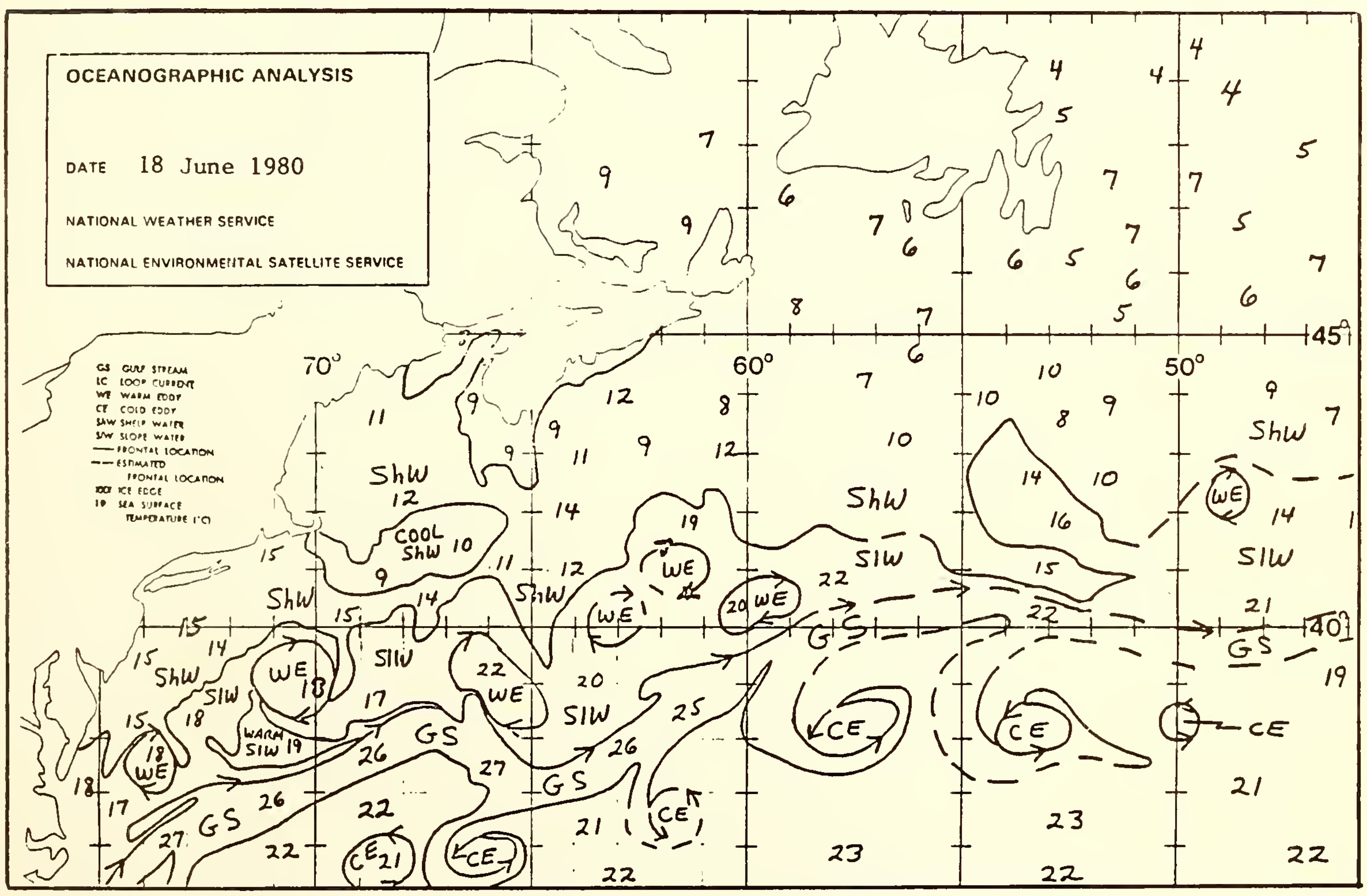


Figure II-7. Example of joint NWS/NESS Gulf Stream chart, combining analyses of satellite infrared imagery with sea surface temperature data from ships and data buoys.

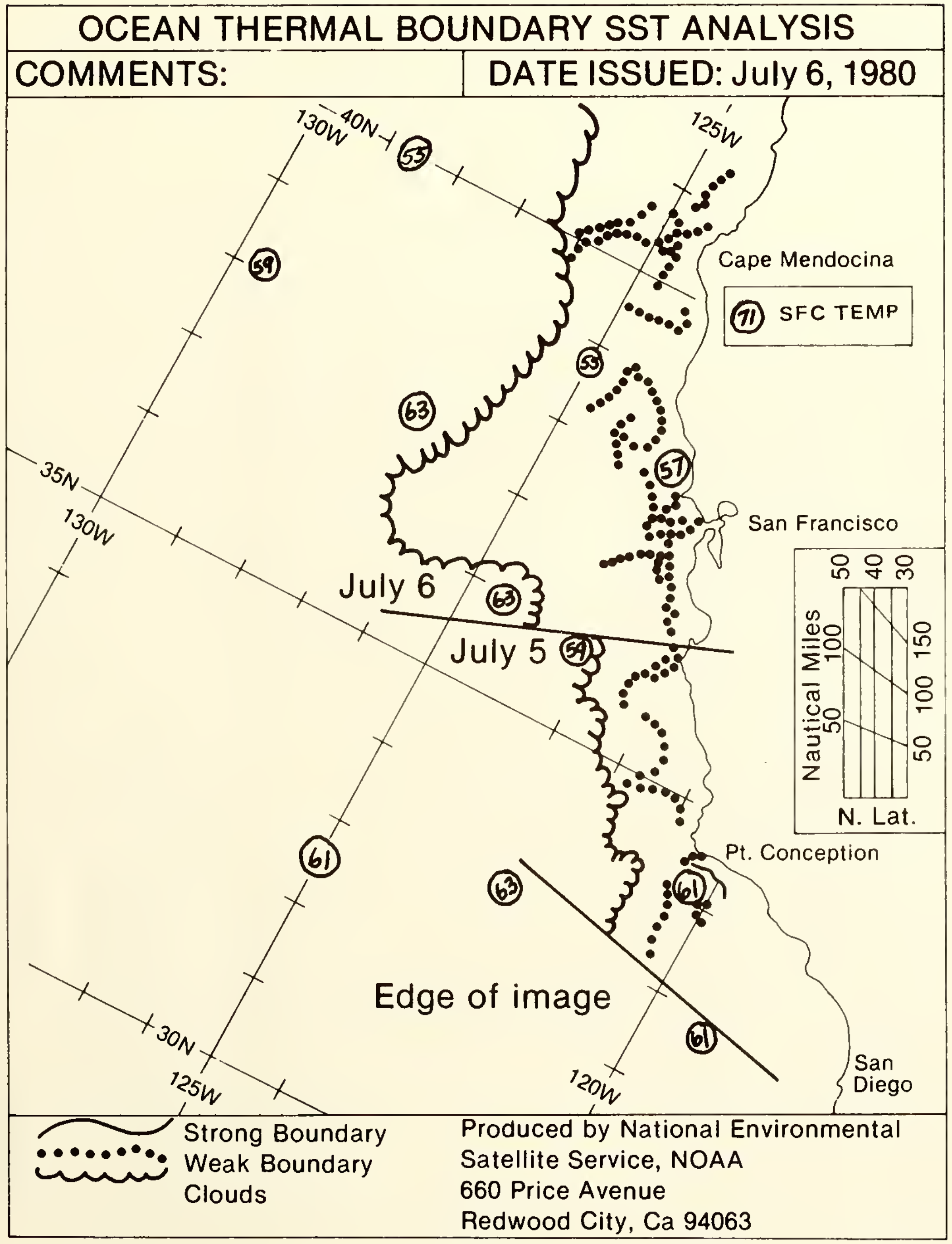


Figure II-8.

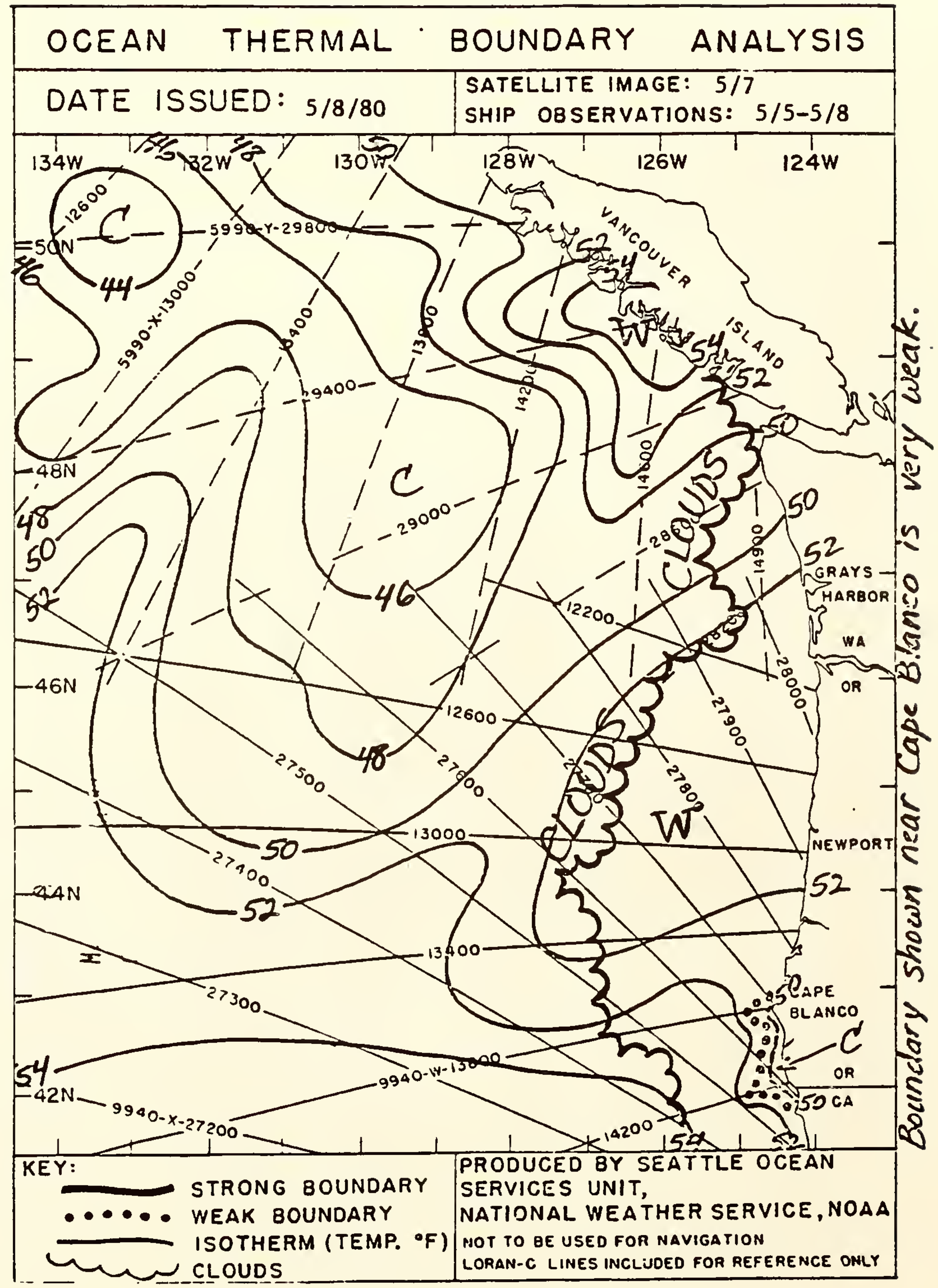


Figure II-9. Example of west coast oceanographic analysis combining ocean fronts observed on satellite infrared imagery with sea surface temperature contours from ships and data buoys

wide environmental (atmospheric, marine, solar and solid earth) data and information for use by commerce, industry, the scientific and engineering communities, and the general public, as well as by Federal, state and local governments. It also assesses the impact of environmental fluctuations on food production, energy production and consumption, environmental quality, and other economic systems; and manages or provides functional guidance for NOAA's scientific and technical publication and library activities. In addition, EDIS operates related World Data Center-A subcenters and participates in other international data and information exchange programs. To carry out its mission, EDIS operates a network of specialized service centers and computerized environmental data and information retrieval services. EDIS' involvement with satellite data services is extensive at present and is expanding to improve support to its users.

Satellite Data Services Division (SDSD): SDSD is an arm of the EDIS National Climatic Center and provides operational NOAA environmental satellite data to secondary users once the original collection purposes (i.e., weather forecasting) have been satisfied. The Division also provides some NASA experimental satellite data, including Seasat data.

Satellite data available from SDSD include:

- Data from the TIROS (Television and Infrared Observational Satellite) series of environmental spacecraft;
- Imagery gathered by the NASA experimental Nimbus-7 and Seasat spacecraft;
- Full-earth disk photographs from NASA's Applications Technology Satellites (ATS)-I and -III geostationary research spacecraft;
- Thousands of images from the original ESSA and NOAA series of Improved TIROS Operational Satellites (ITOS); and
- Full-disc and sectorized images from the Synchronous Meteorological Satellites (SMS)-1 and -2 and the current operational geostationary spacecraft, GOES.

In addition to visible region imagery, infrared data are also available from these satellites. Each day, SDSD receives several hundred negatives from polar-orbiting and geostationary spacecraft and several special negatives and movie film loops. Queries should be addressed to:

EDIS, Satellite Data Services Division
World Weather Building, Room 100
Washington, DC 20233
(301) 763-8111

EDIS Centers and Services: Many applications of satellite data benefit from comparative data sets ("surface truth"). In the absence of real time comparative data sets, historical data are capable of providing a statistical base for comparison. In many cases, continuing satellite observations can be calibrated using historical data and a minimum of absolute surface data.

EDIS operates the following discipline-oriented centers capable of providing historical data and services:

National Climatic Center
Federal Building
Asheville, NC 28801
(704) 258-2850, Ext. 683

National Oceanographic Data Center
2001 Wisconsin Avenue, NW
Washington, DC 20235
(202) 634-7500

National Geophysical and
Solar-Terrestrial Data Center
325 Broadway
Boulder, CO 80303
(303) 497-6215

Additionally, the EDIS Center for Environmental Assessment Services (CEAS) is actively involved in the use of meteorological and

Landsat satellite data in both research and monitoring activities. For further meteorological information, contact:

CEAS
Marine Environmental Assessment Division
3300 Whitehaven Street, N.W., Room 162
Washington, DC 20235
(202) 634-7379

For further Landsat information, contact:

EROS Data Center
USGS
Sioux Falls, SD 57198
(605) 594-6511

The Environmental Science Information Center (ESIC) coordinates NOAA's library and information services and its participation in the national network of scientific information centers and libraries. For further information, contact:

ESIC
Library and Information Services Division
6009 Executive Boulevard
Rockville, MD 20852
(301) 443-8358

4. Seasat and Nimbus-7 Oceanic Applications

Introduction and Sensor Description

Seasat, launched in June 1978, was a proof-of-concept ocean-survey satellite instrumented to measure boundary layer winds, waves, ocean surface temperatures and topography, sea ice and coastal environmental factors. The Seasat mission ended prematurely in October 1978, due to a catastrophic power failure. At that time, about 100 days of global data had been recorded.

Seasat carried five primary sensors.[4] They were:

Altimeter - A nadir-viewing, 3 ns radar operated at 13.5 GHz to measure verticle distance from the spacecraft to the ocean surface, and to measure significant waveheight and surface wind speed.

Seasat Scatterometer System (SASS) - This 14.5 GHz radar illuminated the ocean surface for a distance up to 1000 km on either side of the sub-satellite track, and recorded the strength of the radar return. Surface wind vectors (up to three aliases) were produced for spatial resolution cells 50 x 50 km.

Scanning Multi-channel Microwave Radiometer (SMMR) - This radiometer measured microwave radiation at 6.6, 10.7, 18, 21 and 37 GHz to derive sea surface temperature, surface wind speed (no direction), atmospheric water vapor and liquid water, and sea ice. Only very limited amounts of data have been processed to date.

Visible and Infrared Radiometer (VIRR) - The VIRR was a modified version of the earlier TIROS-type satellite Scanning Radiometer (SR). The VIRR provided earth scene images in the visible and infrared wavelength regions for cloud/land feature identification. In the absence of clouds, the infrared channel provided sea surface temperature features over the oceans.

Synthetic Aperture Radar (SAR) - The SAR, an L-band radar operated at 1.27 GHz, had excellent cloud and rain penetration capability. It illuminated a swath 100 km wide, and provided spatial resolution of 25 m in both range and azimuth. SAR data were used to measure dominant ocean wavelength and direction, to study coastal processes and to provide information on sea and lake ice dynamics.

Nimbus-7 is a research and development satellite for atmospheric sciences, environmental pollution and oceanology. The oceanic instruments aboard this spacecraft are:

Scanning Multi-channel Microwave Radiometer (SMMR) - The SMMR on Nimbus-7 is identical to the SMMR on Seasat as described above.

Coastal Zone Color Scanner (CZCS) - The CZCS measures chlorophyll concentration and the diffuse attenuation coefficient, k. The wavelengths of operation are centered at 443, 520, 550, 670, 750 nm and a thermal channel at 11.5 μm. Spatial resolution is 850 m with a swathwidth exceeding 1500 km.

Both Nimbus-7 oceanic instruments are still collecting data.

Summary of Applications

This section gives examples of measurements taken during the Seasat and Nimbus-7 missions from the heritage instruments for NOSS, i.e., the Altimeter, the SASS, the SMMR and the CZCS.

Winds: Seasat scatterometer-derived surface wind vectors, superimposed on a VHRR image, are shown in Figure II-10 for one of the most intense extratropical cyclones to have occurred over the North Atlantic during the Seasat mission. This storm has been termed the Queen Elizabeth II (QEII) storm since that vessel incurred \$50,000 in damage from high seas and injury to more than 20 of the 1213 passengers when it passed through the most intense portion of the storm in a west-bound trans-Atlantic crossing. At the height of the storm, waves in excess of 50 feet and winds of 60-65 knots were observed.

Shown in Figure II-10 are wind vectors reported by Seasat on two consecutive orbits (1093, 1094), on September 11, 1978, which occurred within hours of 1200 GMT, the time the QEII encountered the worst elements of the storm. Other ships in the vicinity reporting at 1200 GMT on September 11, 1978, established that winds exceeded gale force (35 knots or 18 m/s) at least 550 km in all directions away from the storm center. Comparisons of Seasat wind vectors with analyzed field values show rms errors of 2 m/s in wind speed and 16 degrees in direction.

Waves: Studies of Seasat Altimeter data for significant waveheight ($H_{1/3}$) measurements have been carried out using Ocean Weather Station PAPA and NOAA data buoy observations of sea state for comparisons. Figure II-11 shows a scatter plot of the significant waveheight comparisons. The data are separated into two groups to identify observations taken <80 km and >80 km from the Altimeter measurements. The data show a mean difference of -0.29 m with a standard deviation of ±0.22 m for waveheights ranging from 1 to 5 m.

Currents: Studies of radar altimetry for height measurements are illustrated in Figure II-12 which shows the difference between Seasat Altimeter measurements and a model geoid (GEM 10B) for a $5^{\circ} \times 5^{\circ}$ grid. These Seasat data, taken on July 10, 1978, during orbit 191, commence over Puerto Rico and extend to the shores of the United States. Features of interest are the geostrophic current system of the Gulf Stream, identified by a slope slightly greater than 1 m in about 25 km, and the Puerto Rico Trench which shows a 15-m depression over a distance of about 850 km. These examples show the precision with which measurements of ocean surface topography can be made from satellites. This figure also illustrates the requirement to have a good geodetic data base.

Sea Surface Temperature: As noted in Section 2 above, SST-related measurements are made on a routine basis from operational satellites. The SMMR instrument on Seasat and Nimbus-7 is the first space attempt to measure SST using the microwave portion of the electromagnetic spectrum. The inherent advantage of cloud penetration by microwave energy will eliminate a major impediment found in the measurement with infrared (IR) sensors. However, the advantage gained in penetrating clouds is offset by the poorer spatial resolution and thermal sensitivity of microwave radiometers to measure SST. Hence, the real advantage to the oceanic community is anticipated in merging both IR- and microwave-derived SST data.

The spatial resolution of SMMR for SST is about 100 km, while typical SST data is collected at a single point. The SST comparison between SMMR and expendable bathythermographs (XBT's) is shown in Figure II-13. The filtering indicated on this figure for data processing eliminates (1) all data within 200 km of land; (2) all data contaminated by solar reflection from the ocean

Figure II-10. Queen Elizabeth II (QEII) storm wind vectors

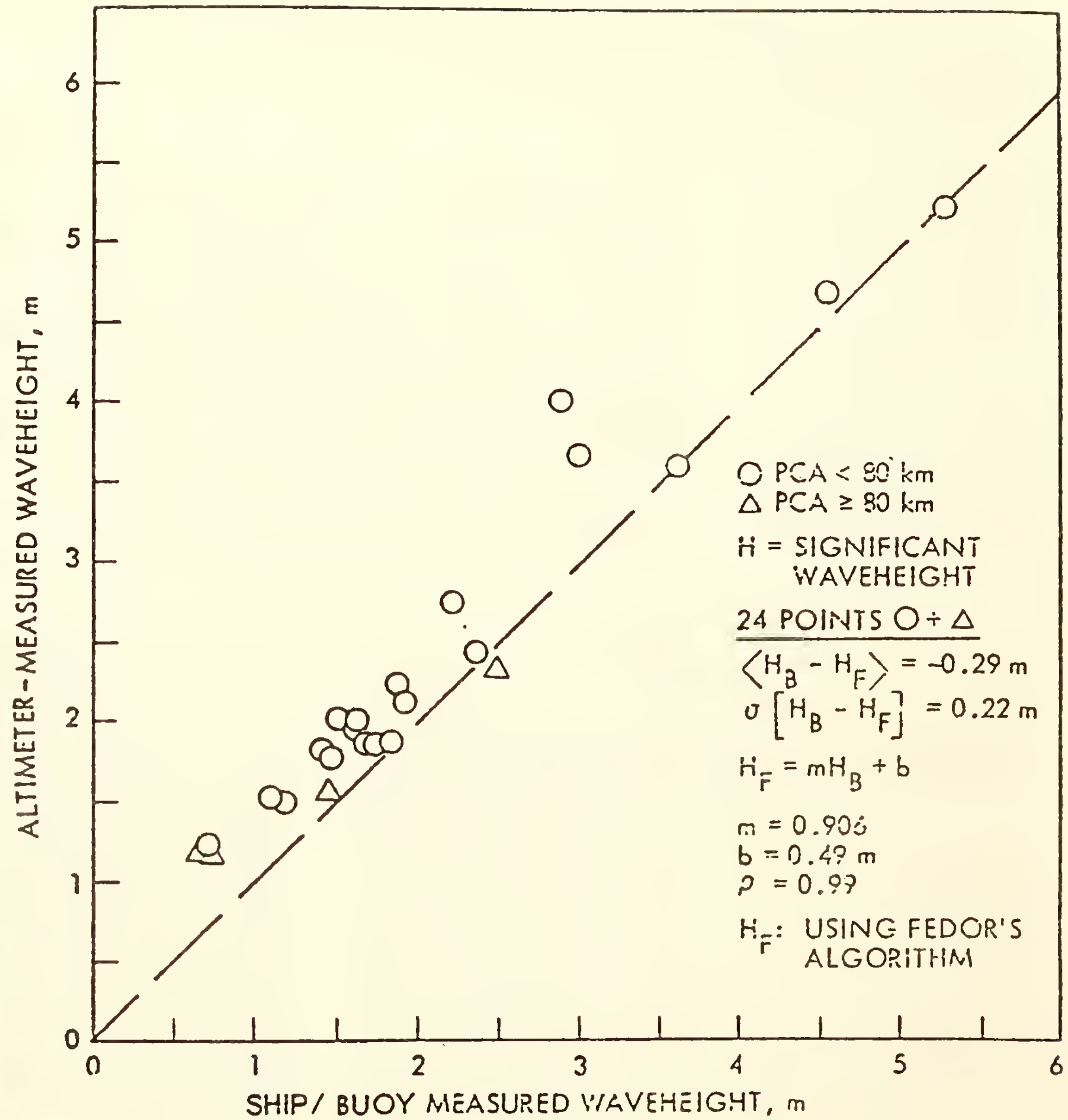


Figure II-11. Scatter plot of significant waveheight comparisons

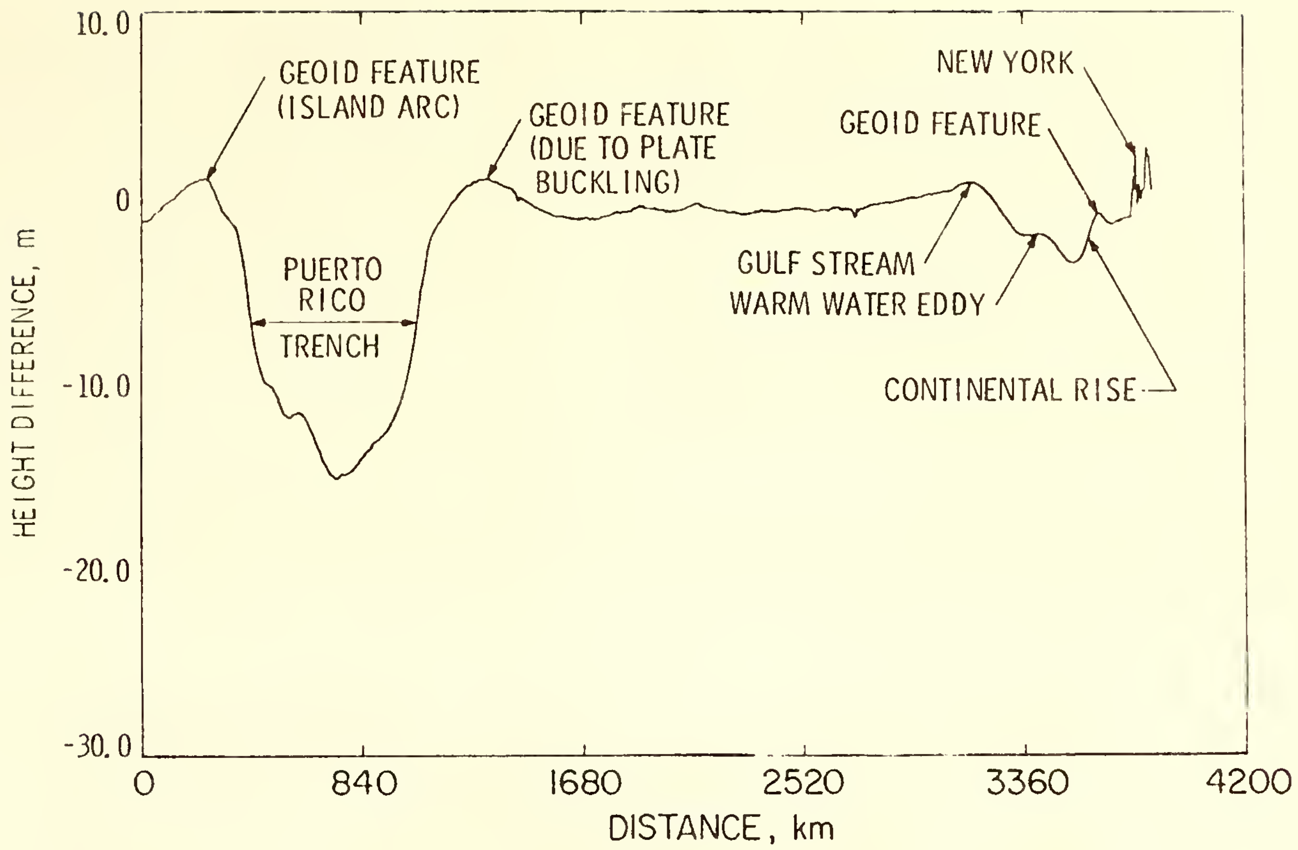


Figure II-12. Difference of Seasat Altimeter Sea Surface Height and GEM 10B Geoid for North Atlantic Pass (7/10/78, Rev 191)

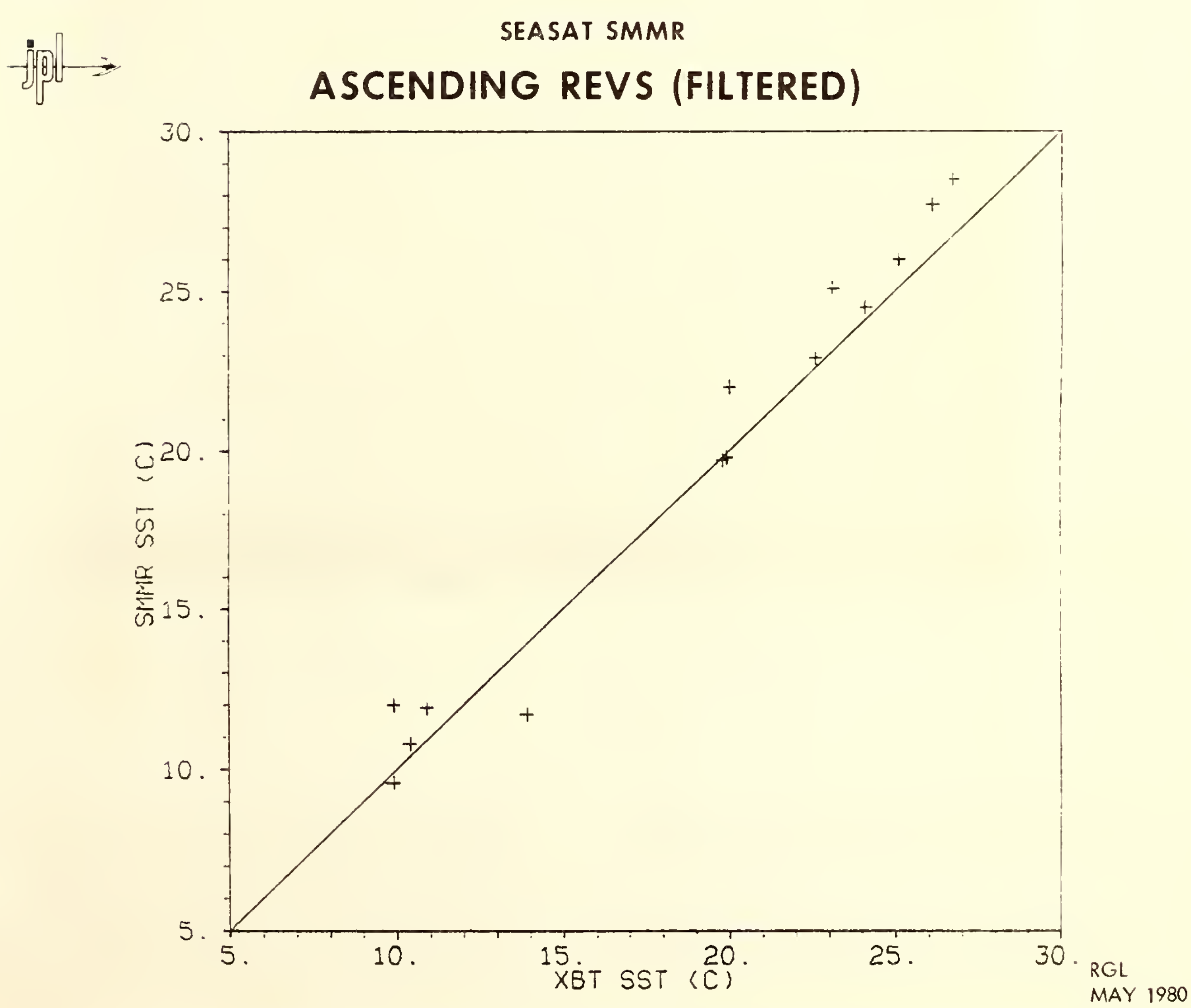


Figure II-13. Comparison of SMMR and expendable bathythermographs (XBT's)

surface; and (3) all data which contain rain. Subject to this filtering constraint, the 14 data points shown have a bias of 0.7 K and an rms error about the bias of 1.2 K. The significant aspect to this type processing is that the unfiltered data set contains 59 data points for direct comparison between SMMR and XBT's. The filtering process eliminates 76% of the data in this example. Filtering is presently required because the SMMR sensor characteristics and algorithms are not sufficiently mature to permit corrections.

Color: The measurement of ocean color can produce either quantitative data, such as an estimate of chlorophyll, or non-quantitative data wherein only ocean front information is derived. In either case the region of interest must be cloud free, and the best results are achieved when atmospheric corrections are made (both Rayleigh and aerosol corrections). Figure II-14 is a scene derived from the Nimbus-7 CZCS in the Gulf of Mexico. Atmospheric corrections have been made. Both ocean fronts and chlorophyll-a plus phaeophytin-a data are contained in the image. Sharp contrasts in the gray scale are regions of optical ocean fronts, while the intensity of the gray scale indicates pigment concentration (higher concentrations are whiter).

Figure II-14. Ocean fronts and chlorophyll-a and phaeophytin-a data for the Gulf of Mexico. Light — high chlorophyll concentration; dark — low chlorophyll concentration.

[1] GOES – Geostationary Operational Environmental Satellite.

[2] TIROS – Television and Infrared Operational Satellite.

[3] Effective July 31, 1980, NESS became the National Earth Satellite Service.

[4] More details on these sensors and those on Nimbus-7 are summarized in Appendix E.

III. NOSS PROGRAM

1. Introduction

The National Oceanic Satellite System (NOSS) is planned as a joint effort by the National Oceanic and Atmospheric Administration (NOAA) of the Department of Commerce (DOC), the National Aeronautics and Space Administration (NASA) and the Department of the Navy for the Department of Defense (DOD). The major elements of NOSS tri-agency organization are composed of representatives from these agencies.

There are currently three levels of NOSS activity represented by: (1) a Steering Committee (Figure III-1) for policy level review, direction and interagency coordination; (2) a Program Management Team (Figure III-1) for management of the overall activities of the program, including mission definition and monitoring performance, cost and schedule, and serving as the primary interface among the participating government agencies; and (3) a NOSS Project (Figure III-2) which is responsible for all aspects of the system acquisition and day-to-day implementation of NOSS, including the A-109 Alternate Concept Studies.

Table III-1 is the Major Milestone Schedule. For the tri-agency segment of this proposed program, the Phase I Design Study Contracts were awarded in August, 1980. The Phase II Award, which is the fabrication and implementation of the system, will be granted subsequently in late 1981. The implementation contract will eventually lead to the launch of the first NOSS spacecraft approximately in mid-1986.

NOSS will be jointly funded and managed by the three agencies. The principal objective of NOSS is:

> To provide a time-limited operational demonstration of global sea surface observational capability based on remote sensing from space.

The goal of NOSS includes the feasibility and value of providing from polar-orbiting spacecraft, in near-real time and under varying weather conditions, continuous observations over the ocean surface. These observations include winds, surface water temperature, waveheight, sea ice, chlorophyll concentration, ocean surface topography and atmospheric water vapor. Previous NASA research and development spacecraft, such as SKYLAB, GEOS-3, Seasat and Nimbus-7 (as outlined in Chapter II), have shown that satellite observations can play an important role both operationally and as a research tool in measuring these geophysical quantities on a global basis. The planned duration of the joint operational demonstration is five years.

NOSS data, due to its coverage and timeliness, should improve the efficiency, safety and economy of: ship operations, transportation, off-shore oil and gas exploration and drilling, platform operations, marine construction, commercial fishing, ice monitoring, and marine search and rescue operations. NOSS also is expected to be especially useful in improving NOAA's global weather forecasting services and to benefit the National Climate Program.

2. NOAA Responsibilities

DOC/NOAA will participate in the NOSS program as a primary user and specifically will address the operational support of the civil marine community, including government and non-government needs for oceanic data. NOAA will participate with NASA in the coordination of the civil research requirements for NOSS. In both areas of participation, NOAA will be committed to the specification, development, validation and operation of NOSS. Additionally, NOAA will provide management and operational functions and facilities to the NOSS tri-agency data archive.

3. NASA Responsibilities

NASA will participate in the NOSS program as the system acquisition and development agency and specifically will address the development of new and advanced technology and of operational instrument, software and spacecraft systems. NASA will also address the requirements of the civil oceanic research community and the interface with the academic institutions and appropriate research advisory bodies (including the National Academy of Sciences), and will coordinate these requirements with NOAA and Navy. To fulfill this obligation,

NOSS Organization

Program Steering Committee

NASA — Dr. A. Calio
DOC/NOAA — D. Johnson
DOD — RADM. R. Williams

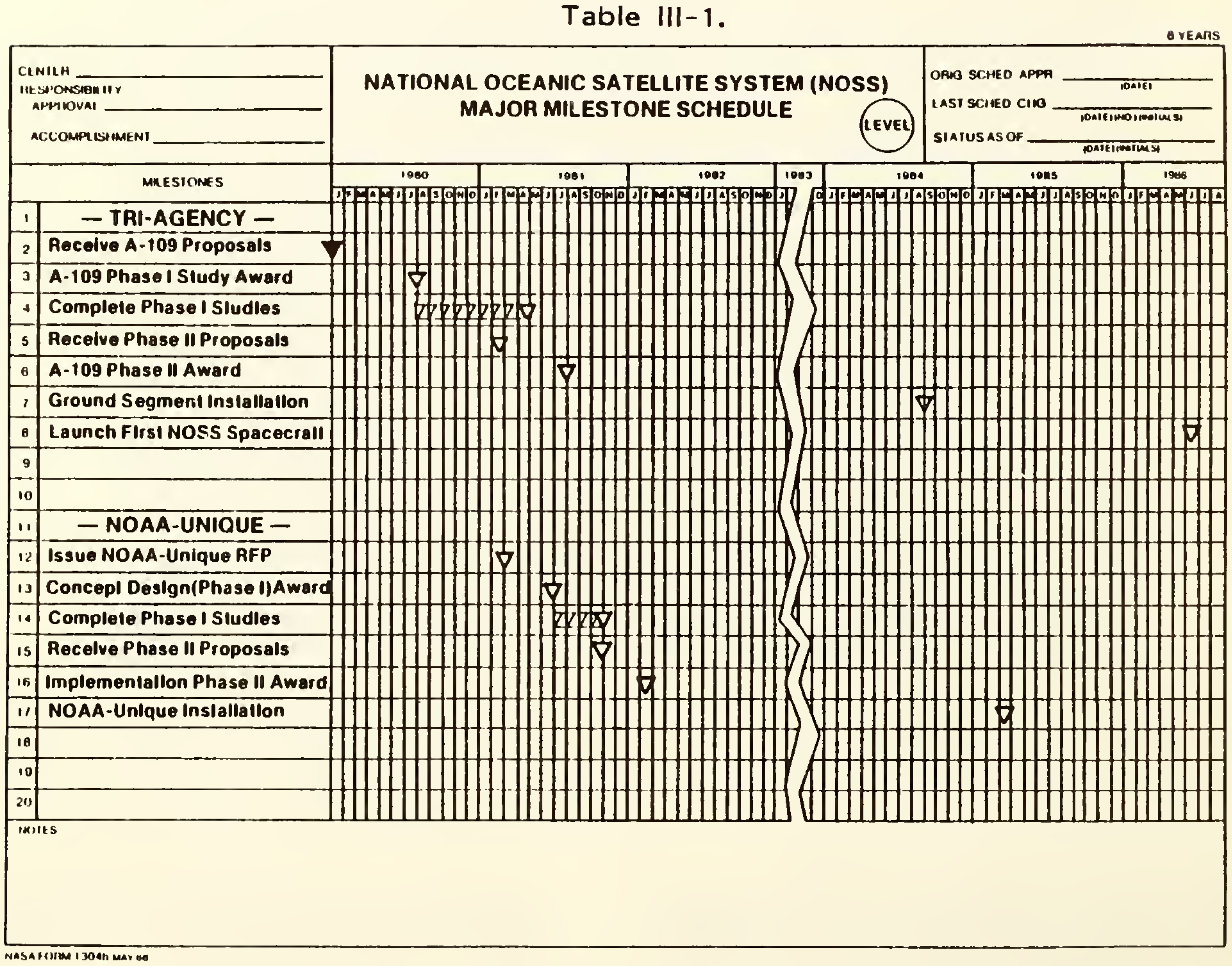
Program Management Team

NASA Chairman — Dr. L. R. Greenwood
Program Manager — D. Broome
Dep. Prog. Mgr. DOC/NOAA — J. Hussey
Dep. Prog. Mgr. DOD — Capt. H. Nicholson
Project Mgr. — G. Branchflower

NOSS Project

Figure III-1.

Table III-1.



NOSS PROJECT ORGANIZATION

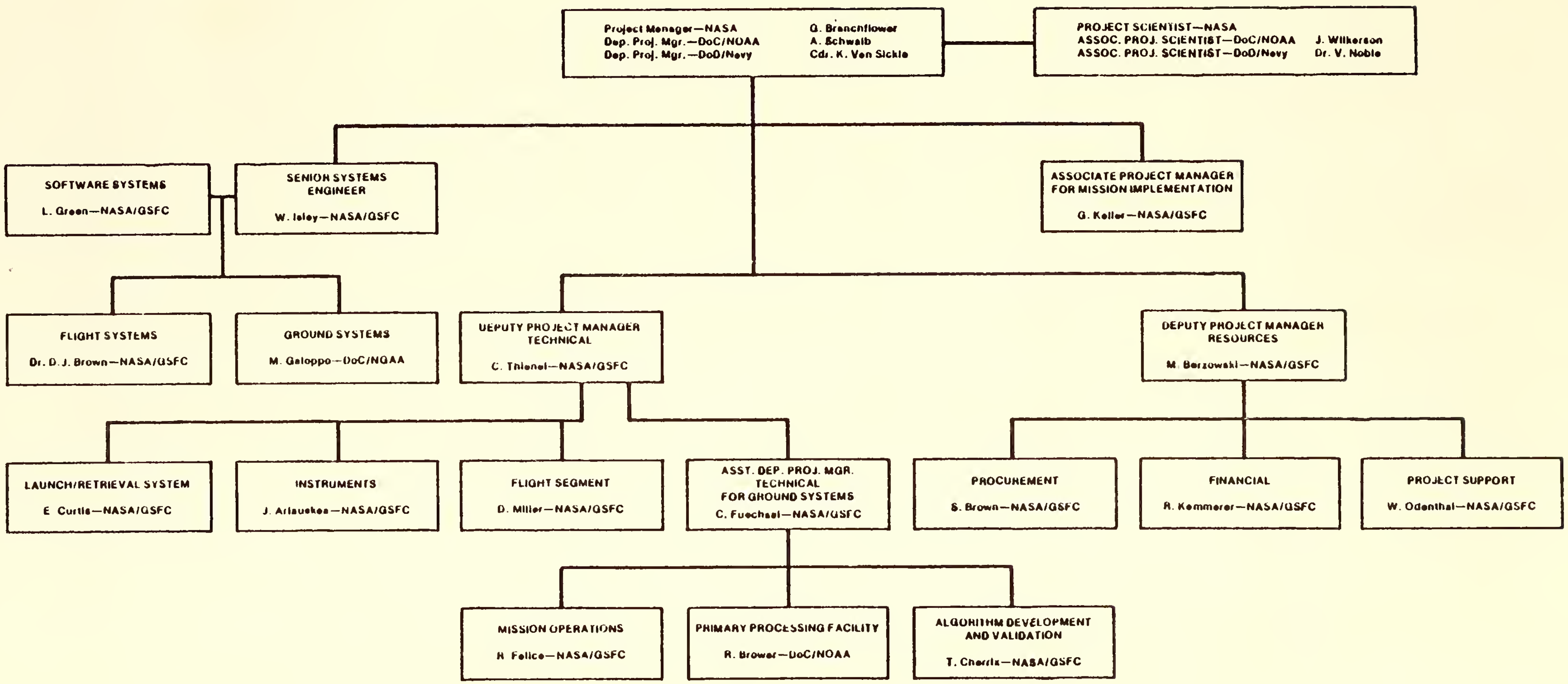


Figure III-2.

NASA will be the lead agency in the technical specification, development, procurement, tests, launch, and prevalidation operation of NOSS and its sensor payloads.

4. Navy Responsibilities

DOD/Navy participation in NOSS is similar to that of NOAA but addresses oceanic support to all national defense forces.

5. Tri-Agency Program

NOSS will consist of two major parts, the flight segment and the ground segment as illustrated in Figure III-3. The flight segment will be launched by the space shuttle, and other supporting propulsion systems, to an operating altitude of 600-900 km. This segment includes a spacecraft "bus" and a specific instrument complement. The spacecraft "bus" will provide power, altitude and thermal control, communications, command control, data handling, and the necessary propulsion capability to attain mission orbit from the lower shuttle orbit and then return, if required. The instrument complement is discussed subsequently.

The tri-agency ground segment is a combination of systems which, in conjunction with the Tracking and Data Relay Satellite System (TDRSS) and a domestic communication satellite service, will provide the in-orbit operation, ground data processing and distribution functions for the NOSS mission. This segment includes a Primary Processing Facility, the satellite and system control facilities, an archiving facility, and the interfaces with the primary user (NOAA and Navy) processing centers. Table III-2 indicates the major functional ground components for the tri-agency NOSS end-to-end system.

A set of oceanic data requirements developed by NOAA, Navy and NASA (Table III-3) has been used as a goal for the NOSS measurements of the marine environment. These geophysical requirements define the maximum expectations that might realistically be achieved by an operational satellite system. The NOSS program is responding to these requirements by including four "higher heritage" instruments on the NOSS spacecraft.[5] The philosophy guiding this higher heritage implementation by NOSS is to utilize Seasat and Nimbus-7 sensor designs with modifications, and to base the initial versions of operational algorithms and expectations for accuracy and precision of measurement on results of Seasat and Nimbus-7 experiments.

The NOSS Sensor Payload includes the following basic instruments:

- o Large Antenna Multichannel Microwave Radiometer (LAMMR);
- o Coastal Zone Color Scanner (CZCS);
- o Altimeter; and
- o Scatterometer.

The Large Antenna Multichannel Microwave Radiometer (LAMMR) currently under development is a much larger version (4-meter diameter antenna) of the Scanning Multichannel Microwave Radiometer (SMMR) flown on both Seasat and Nimbus-7. Its primary usage is to monitor sea surface temperature, surface wind speed, and sea ice, and to provide atmospheric corrections for the altimeter and scatterometer instruments.

The Coastal Zone Color Scanner (CZCS) is the same as that flown on Nimbus-7, except for the addition of three channels. Primary usage is to monitor chlorophyll concentration and the diffuse attenuation coefficient (turbidity). The CZCS contains a single thermal-infrared channel for sea surface temperature measurement.

The Altimeter is essentially the same instrument flown on Seasat, except that two are being flown on NOSS for redundancy in order to extend the operational life requirements of the system. Primary usage is to monitor ocean waves, ocean surface topography, and ice sheet height and boundaries.

The Scatterometer is an improved version of the Seasat Scatterometer System (SASS). The NOSS version will have six antennas instead of four and will also have redundant electronics.

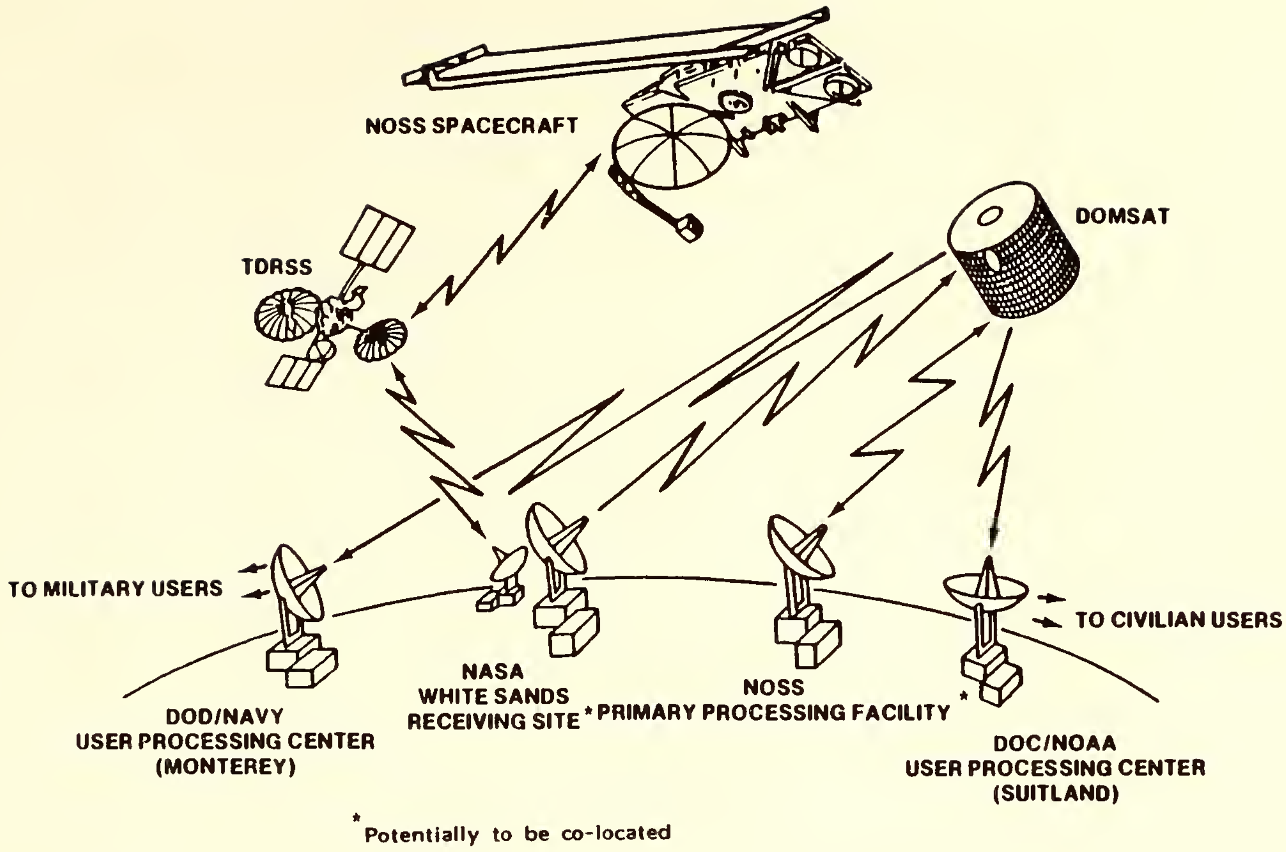


Figure III-3. NOSS End-To-End System

Table III-2.

MAJOR FUNCTIONAL COMPONENTS OF TRI-AGENCY NOSS

- **NATIONAL OCEANIC SATELLITE—sun-synchronous earth-orbiting spacecraft consisting of a complement of four instruments to measure oceanographic parameters.**
- **PRIMARY PROCESSING FACILITY (PPF)—responsible for acquiring and processing raw spacecraft instrument data into calibrated and earth located geophysical data for the primary users (NOAA and DOD/Navy)**
- **SYSTEM CONTROL CENTER (SCC)—nerve center for all NOSS operations. Responsive to management directives of NOAA and DOD/Navy.**
- **SPACECRAFT OPERATIONS CONTROL CENTER (SOCC)—responsible for the continuous monitoring and control of the satellite to ensure the health and safety of the spacecraft.**
- **DOMSAT COMMUNICATIONS—provides for transmission of NOSS data products from PPF and primary user processing centers.**
- **DATA ARCHIVE—provides for archive of all PPF products.**

Table III-3.

National Oceanic Satellite System

Goals for Operational Geophysical Measurements

Parameter	Accuracy	Resolution	Frequency	Delay
Wind				
Speed	2 m/s	25km	12h	3h
Direction	10 deg	25km	12h	3h
Sea Surface Temperature				
Global	1.0°C	25km	3 days	12h
Local	0.5°C	10km	1 day	12h
Waves (Sea State)				
Significant Wave Height	0.3m	25km	12h	3h
Direction	10 deg	25km	12h	3h
Ice				
Cover	15%	20km	3 days	12h
Thickness	2m	50km	3 days	12h
Age	New, 1st Yr, Multi-Yr	20km	3 days	12h
Sheet Height	0.5m Change	10km	1 year	30 days
Water Mass Definition				
Chlorophyll	Within Factor of 2	0.4km	2 days	8h
Turbidity	Lo, Med, Hi	0.4km	1 day	10h
Horizontal Surface Currents				
Speed	5 cm/s	20km	1 day	1 day
Direction	10 deg	20km	1 day	1 day

Table III-4.

NOSS SENSOR CHARACTERISTICS

Sensor	No. of Channels	Data Rate	Resolution	Swath Width	Comments
LAMMR	7 Frequencies: 4.3, 5.1, 6.6, 10.65, 18.7, 21.3, 36.5 GHz	60 kbps	25 km for SST 9 km for Ice	1350km	Passive Sensor 4m Offset Parabolic Antenna
CZCS	9 wavelengths 440, 490, 560, 590, 650, 685, 765, 867 nm, 11.5 μm	950 kbps (25% duty cycle)	825m	1500km	7 Visible, 1 Near IR and 1 Far IR Channels
Altimeter	13.5GHz	8.5 kbps	<10km	50km	Active Radar (2 Units per Spacecraft 1m Antenna)
Scatterometer	14.6GHz	20 kbps	50km Over Primary Swath of 500km	1200km	Active Radar (6 Antennas)

Primary usage is to monitor surface wind velocity (speed and direction) over the oceans.

A summary of the general characteristics of NOSS sensors is given in Table III-4 with more detail in Appendix F. These instruments will provide data converted to geophysical quantities, time-indexed, earth-located and provided in a convenient format to the primary user centers of NOAA and Navy. The primary users will further process and distribute oceanic products derived from the NOSS data to their respective end users on a routine, timely basis. In addition, the basic sensor data (Level-I, discussed subsequently) will also be made available by NOAA to the civil user community as required.

6. NOAA Oceanic Data System

NOAA will represent the civil user sectors, both public and private, for operational applications of NOSS. The NOAA Oceanic Data System (NODS), the portion of the NOSS system that will receive data from the tri-agency Primary Processing Facility, performs additional processing on these data and distributes the data to the civilian user community. A team of technical experts from various NOAA elements has been established to work on the design and implementation of the NODS in support of those NOSS responsibilities solely delegated to NOAA. The milestone schedule for this activity also is shown in Table III-1. The installation of this data processing and dissemination system is planned for 1985.

The most important function of the NOAA Oceanic Data System is the management and handling of data. The system must receive Levels-I and -II data from the tri-agency Primary Processing Facility and send the data to the appropriate NOAA systems which process them to Levels-III and -IV. Table III-5 describes the various data levels. It should be noted that other satellite and conventional data, in addition to the NOSS data, will be assimilated in Levels-III and -IV. Level-III data will consist of analyzed products, such as contoured sea surface temperature charts, and Level-IV data will consist of forecasts.

NOAA is also responsible for distributing NOSS near-real time data to the end users of the civilian community. The two general classes of distribution systems that may be utilized are first, the distribution to standard user terminals, and second, the distribution to other computer installations. The distribution of data to NOSS user terminals may be via standard dial-up or permanently connected commercial telecommunications services. The design of the first type of distribution system will be tailored to support image and graphic terminals. The second type of data distribution will be tailored to support the efficient transfer of data between NOAA and end-user computer installations.

NOAA's EDIS will provide the worldwide user community with non-real time (retrospective) NOSS data reproduction and dissemination services. Earth-located, calibrated, and time-tagged sensor data (Level-I) and sensor-measured quantities converted to geophysical units (Level-II) will be provided from the NOAA/EDIS managed tri-agency archive. Sensor-measured quantities, processed into analyzed geophysical fields (Level-III), and possibly forecast type products (Level-IV) processed by the NOAA or Navy systems and provided to the EDIS archive, will also be available along with a catalog of all archived products.

Users may:

- o Access and browse the NOAA/EDIS catalog directly via computer terminal, or indirectly by letter or telephone;
- o Place requests for data by computer terminal, letter or phone;
- o Obtain tailored data products extracted from original data;
- o Specify data type, sensor or parameter at a given location or area for a specific time and receive an extract based on these conditions;
- o Receive data in the form of computer compatible tape, printed hard copy, imagery or possibly through a computer terminal;

- Obtain statistical summaries computed in real time from Levels-I and -II archived data consisting possibly of means, extremes, variances or histograms on a particular grid spacing; and

- Obtain information on the algorithms used to produce the various levels of products to permit reconstruction using the Level-I data.

NOAA/EDIS is flexible concerning these services and products. Ideas and comments are welcome so that other services or products of benefit to the user community may be considered. These comments should be submitted to the same address cited in Appendix B.

Table III-5.

NOSS DATA TYPES

A. To be processed by Tri-Agency PPF:

Level I: Sensor data output—earth located, time tagged in engineering units.

Level II: Geophysical data output—earth located, time tagged in geophysical units.

B. To be processed by Primary User Centers:

Level III: Assimilated and mapped geophysical data sets—includes contouring, spatial and temporal averaging, etc. Other satellite and conventional data will be used.

Level IV: Outputs from forecast models and other special processing

[5] "Higher heritage" instruments imply sensors that have had research to demonstrate the concept. Appendix F summarizes the characteristics of the NOSS baseline sensors.

IV. REVIEW OF CONFERENCES

1. Structure of Conferences

The objectives of the five NOSS Conferences were stated in the Introduction. These Conferences were held at the following locations and times:

Seattle, Washington	May 19
La Jolla, California	May 22
Woods Hole, Massachusetts	May 28
Key Biscayne, Florida	June 3
Bay St. Louis, Mississippi	June 5

At each location, a NOAA component served as host or co-host of the conference with the National Marine Fisheries Service (NMFS) regional centers serving all five conferences. In Seattle the conference was co-hosted by the Pacific Marine Environmental Laboratory, and in Key Biscayne by the Atlantic Oceanographic and Meteorological Laboratory.

The format at each Conference was the same, with the morning sessions devoted to presentations by NOAA, outlining the material presented in Chapters II and III of this report, and with the afternoon sessions focused on requirements of the potential users of NOSS data and derived products. The agenda for a typical conference was:

Agenda

Morning

- o Welcoming Address
- o NOAA's New Space Mission
- o NOAA's Existing Satellite Marine Products
- o Seasat and Nimbus-7 Experience
- o NOSS Program Overview
- o NOAA-Unique Interface[6]

Afternoon

- o Topical Group Meetings[7]

  Group 1. Operational Users (Purpose and Scope, Real Time Data Interface, User Product Requirements, Requirements Discussion)

  Group 2. Research and Development Users (Purpose and Scope, Sensor Description, Opportunities for Research, Requirements Discussion)

- o Review of Group Findings
- o Continuing Interaction with NOSS Program
- o General Discussion

During the topical group meetings, which began the afternoon sessions, the requirements discussion centered around the Conference Worksheet (See Appendix B). This Worksheet formed the basis for individuals and organizations to become more specific in terms of marine data and information expectations from the NOSS program. A summary statement was made by the respective moderator of each topical group to all Conference attendees. A discussion of mechanisms for continuing interaction with the NOSS Program and a general question and answer period concluded each Conference.

Worksheets submitted to NOAA by June 23, 1980, form the basis for the analyses. These analyses, combined with the highlights of the topical group meetings, make up the general findings and concerns presented at the close of this chapter.

2. Participation

A broad spectrum of marine data and information users and managers participated in the Conferences. These participants, as well as the program presenters, are listed in Appendix A. Approximately 430 persons registered[8] at one or more of the Conferences, in which 118 or 33% were from commercial (non-profit or private) industry (Table IV-1); 70 or 19% from academic institutions (Table IV-2); and 177 or 48% from government agencies (Federal, state, local and foreign as shown in Table IV-3). An analysis of these participants reveals that:

40 attendees or 11% were in Seattle;

85 attendees or 23% were in La Jolla;

73 attendees or 20% were in Woods Hole;

35 attendees or 10% were in Key Biscayne; and

132 attendees or 36% were in Bay St. Louis.

NOAA personnel represented 29% of the government attendees, or 15% of all participants.

3. Highlights of Topical Groups

Introduction

The afternoon session of each Conference focused on requirements of the potential users of NOSS data and derived products. In order to facilitate the discussion, the users were divided into two topical groups, operational users and research and development (R&D) users. The operational users group was concerned with the near-real time data interface and user product requirements, whereas the R&D users group concentrated on sensor description, opportunities for research and retrospective (non-real time) data services. This placement of retrospective considerations with the R&D section of the Conference was for convenience in maintaining only two groups. It was not intended to imply uses of retrospective data are limited to the R&D community. Both groups used the Conference Worksheets as a basis for questions and dialogue concerning marine data and information expectations from the NOSS program. Following the group sessions, the respective moderator of each topical group presented a summary statement of his/her group's discussion to all Conference attendees. Table IV-4 lists the moderators of each group for all Conference sites. The results of the operational and R&D topical groups are discussed only in terms of themes common to all groups.

Commonality of Dialogue

Each Conference attendee voiced and listened to concerns, issues, needs and activities with regard to the potential NOSS support to their on-going operations or program requirements. Currently, near-real time, synoptic, geophysical data are limited in duration and availability to essentially all marine users. These data limitations apply to local, regional and global needs. Buoy, ship and fixed platform data collection on a routine basis remains the backbone of present-day data collection, and is viewed by a vast majority of users to be an inherent element in any marine data system.

To summarize the topical group discussions, and the subsequent presentation by each group moderator, is a task that involves not only the Conference discussions but also the viewpoint of the Conference coordinator. Therefore, the reader should recognize that this documentation is what has been "heard" at these Conferences and, as such, becomes a mechanism for continuing the real purpose of these Conferences; i.e., to obtain early involvement of potential NOSS users. Thus, NOAA management solicits comments on this report as a means of continuing dialogue with the marine community.

While discussed in different terms and formats, the following seven points were common to all topical groups:

- Support for NOSS
- Credibility
- Validation

Table IV-1

COMMERCIAL USERS

Louis C. Adamo, Inc.	D.E. Britt Associates, Inc.	Oceanroutes, Inc.
Aerospace Corporation	Del Norte Technology, Inc.	Ocean Data Systems, Inc.
Aerojet Electro Systems	Dames & Moore Consultants	Optronics International
Alden Electronics	E G & G Environmental Consultants	Peace Publications
American Institute of Aeronautics & Astronautics	Environmental Devices Corporation	RCA
Ametek Straza	Environmental Research Technology, Inc.	Raytheon
Analytic Sciences Corporation	ESCA-Tech Corporation	Rockwell International
ARINC Research Corporation	General Electric	Sanders Associates
Battelle Columbus Laboratories	Geo-Atmospheric Corporation	Satellite Business Systems
Bendex Corporation	Global Marine Development	Science Applications, Inc.
Benthos, Inc.	Harbor Branch Foundation	SEA USE Council
Boeing Aerospace Company	HARRIS Corporation	Sippican Corporation
Coastal Engineer, Inc.	Interocean Systems, Inc.	Stanford Research Institute (SRI) International
Computer Sciences Corporation	JoEllen Smith Memorial Hospital	System Development Corporation
Conoco, Inc.	Lockheed Missiles & Space Company	T Systems, Inc.
Control Data	Lockheed Ocean Laboratory	TRW-Defense & Space Systems Group
Crouse-Hinds Electro	Marine Electronics Service, Inc.	Technology Development of California
Crowley Maritime Corporation	McDonnell Douglas	Teledyne Systems
D.P. Associates	Mitsubishi Electric Corporation, Japan	Texaco, Inc.
	Nekton, Inc.	ZAND, Inc.

Table IV-2

ACADEMIC INSTITUTIONS

Bedford Institute of Oceanography	University of Alaska
Johns Hopkins University	University of California at Santa Barbara
Jackson State University	University of Illinois
Louisiana State University	University of Massachusetts
Massachusetts Institute of Technology	University of Miami
Mission Bay Aquatic Center	University of Mississippi
Scripps Institution of Oceanography	University of New Hampshire
Southern Maine Vocational & Technical Institute	University of Rhode Island
State University of New York at Oneonta	University of Southern California
Texas A & M University	University of Washington
U.S. Coast Guard Academy	Western Washington University
U.S. Naval Academy	Woods Hole Oceanographic Institution

Table IV-3

FEDERAL GOVERNMENT AGENCIES

DEPARTMENT OF COMMERCE –

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

Office of the Administrator

Office of Public Affairs

Office of Fisheries

Office of the Assistant Administrator for Fisheries
Northwest and Alaska Fisheries Center
Southeast Fisheries Center
Northeast Fisheries Center
Southwest Fisheries Center

Office of Research and Development

Atlantic Oceanographic and Meteorological Laboratories
Pacific Marine Environmental Laboratory
NOAA Data Buoy Office

Office of Oceanic and Atmospheric Services

Office of the Assistant Administrator for Oceanic and Atmospheric Services
National Earth Satellite Service
National Weather Service
National Ocean Survey
Environmental Data and Information Service

DEPARTMENT OF THE NAVY –

Office of Naval Research

Naval Environmental Prediction Research Facility

Naval Oceanography Command

Naval Oceanographic Office

Naval Ocean Research and Development Activity

Navel Ocean System Center

Naval Underwater Systems Center

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA) –

NASA Headquarters

Earth Resources Laboratory

Goddard Space Flight Center

Jet Propulsion Laboratory

Pacific Missile Test Center

GENERAL SERVICES ADMINISTRATION –

Region 1

DEPARTMENT OF THE INTERIOR –

U.S. Geological Survey

LOCAL AND STATE GOVERNMENT AGENCIES

FLORIDA –

Department of Natural Resources

Environmental Quality Control Board – Broward County

Sea Grant

MAINE –

Land Use Regulation Commission

MISSISSIPPI –

Mississippi-Alabama Sea Grant Consortium

NEW JERSEY –

Marine Advisory Service

WASHINGTON –

Department of Natural Resources

Sea Grant

FOREIGN GOVERNMENT AGENCIES

CANADA –

Atmospheric Environment Service

EUROPEAN SPACE AGENCY

- o Communication
- o Availability
- o Commitment
- o Training

A myriad of potential users made common points, varying from the need for hemispheric information on the state-of-the-sea to the local relay of medical information on unfortunate seafarers who require immediate transmission of vital signs. Each user appears to view the satellite approach as a means of augmenting and improving the always present paucity in marine data from conventional sources. The users, be they commercial, academic or governmental, support the NOSS concept. It remains as a continuing exercise for NOSS planners to establish a common denominator of these users' needs for data and information products and to satisfy these requirements within the constraints of available resources.

Support for NOSS: The participation of users at these Conferences demonstrates their interest and support for the NOSS concept. The attendees sought information on the system and discussed actively the general needs and formats for data. However, specific recommendations and requirements are difficult because of the very limited familiarity of the majority of users with satellite-derived wind, wave, ice, water mass definition and circulation information.

Credibility: This is the most serious concern expressed by users because many can not obtain useful data from presently operating experimental satellites in months, yet NOSS is indicating only hours of delay. Credibility is also lacking because satellite data are often not consistent in format and quality. Indeed, the more outspoken discussants expressed the view that the oceanic community does not want to wait for NOSS to have the improved NOAA data distribution system that is planned to accompany the proposed tri-agency NOSS Program. Such a system should have the capacity to handle NOSS-derived data in 1986 but would operate now to distribute, in a timely manner, the buoy, ship and existing satellite data. This in-place data distribution system, operating prior to NOSS, would provide not only the debugging of the ground operation, but also would permit training and experience using limited existing data.

Validation: Users support and encourage the planned confirmation of NOSS performance by the NOSS Project. The commitment by the Project to conduct major experiments involving comparative data sets (surface truth from all other marine data sources) during the early part of the NOSS demonstration is regarded as essential to the Program. However, the users, be they research or operationally oriented, believe that the actual NOSS validation is an exercise which includes the evaluation of performance by the marine community, not solely by the NOSS Project. As such, users should be a major element in the Project validation plan. Such a validation plan would include selected specific users making use of products representative of the marine community served by NOSS. A point was made that the success of NOSS will be judged best by those whom NOSS will serve and not by those who serve NOSS.

Communication: The Conference attendees uniformly support the requirements for NOSS products and data distribution as well as the initial efforts put forth by NOAA to involve the marine community. These Conferences are believed by all to be a major mechanism for effective two-way communication between NOSS planners and users. NOSS planners are encouraged to continue such Conferences, if resources are available.

Also included as an element of communication is the need for potential NOSS users to understand from other operational and research users what is being accomplished now via satellites and what can be accomplished in the future using Seasat and Nimbus-7 as models. In short, the brief overview of these activities at the five Conferences may have whet the appetite but did not satisfy the hunger for understanding the capabilities and limitations of satellite-derived oceanic data.

Availability: Data availability ranked next to credibility as a major concern. Data availability includes vessel-at-sea needs, protected considerations, compatibility with other data sets and specific sources for data.

Full-resolution, vessel-at-sea geophysical data sets that cover the proximity of the vessel operation are required. (This has been interpreted as an area of 1 to 3 days of vessel travel time, or local data sets according to the local, regional and global data scales.) NOSS, as the first operational demonstration of synoptic marine data and information, will not have the most rudimentary form of data availability (direct transmission) found on many previous operational environmental satellites which supported the meteorological community. In particular, the oceanic community appears to be well aware of the early Automatic Picture Transmission (APT) capability and feels that the remote location of vessel-at-sea situations is a stronger requirement than the land-based meteorological requirement which is more readily served by centralized facilities.

The users' concern with availability of data does not imply that there is dissatisfaction with the NOSS concept per se, but that the NOSS planners have not gone far enough in planning for the at-sea availability of the data. Users urge that the vessel-at-sea requirement include the large technical break-throughs occurring in the mini-computer field as the most realistic approach for designing this aspect of the system. A major overhaul in vessel-at-sea reception is required if NOSS is to be effective outside the improvement anticipated in marine forecasts (Level-IV).[9] Time-and-time again, users reiterated the limits of present-day surface communications systems for ships.

The second concern on availability focuses on protected data. Nearly all users understand the need to deny data on a near-real time basis in specific oceanic areas for national security reasons. Users request that the criteria for data denial be established and made known and strongly urge that near-real time denied data be made available retrospectively.

The third point of discussion concerning availability centers on compatibility of NOSS data with other forms of surface and satellite data. If, for example, sea surface temperature (SST) derived from other satellites is not geometrically corrected along with similar corrections for NOSS data, then direct comparisons will be difficult (if not impossible for near-real time users). Formats and standards need to be prepared for user review and comment before being formalized for implementation.

The last concern about availability deals with providing users with focused points of contact to receive oceanic data. Presently users interface with five different elements of NOAA (NWS, EDIS, NOS, NMFS, and NESS), depending on data type or source. Civil users anticipate that a major success for the NOSS Program may not lie in achieving the National Oceanic Satellite System but in creating a national oceanic data system.

Commitment: An area for review and agreement between NOSS and the users is the five-year operational demonstration limit for NOSS. Some users appear unwilling to invest in NOSS-related user equipment, such as receivers and display units, especially for vessel-at-sea situations, unless a commitment is made that a NOSS compatible capability will follow.

Training: Outside those research scientists involved in oceanic remote sensing, few users feel comfortable in defining how best to incorporate NOSS-derived data and information into their activities. Users express a need for more "hands-on", day-to-day experience to permit training and technique development before launch.

A Special R&D Topical Group Concern

The potential of the four operational sensors on NOSS to improve basic knowledge of ocean physical and biological dynamics remains as an undefined NOSS Program area. To realize further operational benefits from other possible NOSS follow-on systems, an effective research and development program must be undertaken. The concern of the R&D groups does not focus on the lack of such an R&D effort within the overall NOSS activity, but on the basic problems of how to assimilate, process and analyze large data sets that the NOSS system will provide. No major computer system within the United States has or will have the capability to support NOSS R&D, unless plans are made early to provide such a facility.

Oceanic remote sensing researchers indicate that, to date, the majority of their efforts in working with satellite data have been directed toward doing computer investigations, not scientific studies. Properly trained computer experts, in conjunction with an appropriate computer facility, would significantly improve productivity and results. Toward this end, researchers request that consideration be given to creating a national facility with possible regional and local terminals to augment both the NOSS operational sensor analyses as well as the 25% R&D growth capabilities planned for the system. Estimates of only 1% to 5% of the total NOSS data set would be processed at such a facility.

4. Worksheet Analyses and Results

The Conference Worksheets (Appendix B), completed by 144 persons (as of June 23, 1980), form the basis of the analyses presented in this section. These Worksheets were submitted by 31 commercial (private or non-profit) company representatives, 41 academic institution representatives, and 71 government representatives (including 8 state and 1 foreign). The summary of the organizational types submitting Worksheets is given in Table IV-5. Since a reasonable cross-section of potential NOSS users submitted Worksheets, it is believed that the findings and concerns drawn from these analyses are valid.

The analyses are related directly to questions 3 through 11 and 13a of the Worksheet. (Summaries of the individual responses to each question are tabulated in Appendix B.) The presentations in this Chapter have been normalized to the Worksheet responses within the three groups of commerce, academia and government, such that the sensitivity of the responses to each question is not dominated by the larger number of Worksheets[10] submitted by government-affiliated people. These initial analyses have not included other alternative combinations, such as a determination of responses according to R&D, engineering, forecast & prediction, and petroleum categories. Such analyses may be useful at a future date, but the categories of commerce, academia and government are thought to be the most useful basis for initial analyses.

Spatial and Temporal Resolutions Needs (Question 3)

The NOSS Program goals for operational geophysical measurements were delineated in Table III-3. These goals are being sought for the NOSS Level-II (geophysical) data products, but are not necessarily those that will be achieved by the system. For example, the temporal coverage achievable by a single satellite system with an orbital altitude of 700-900 km is not 12 hours, but typically between 2 and 3 days, depending on the swathwidth of the particular satellite sensor (See Appendices D and F).

As a measure of the response of the NOSS goals to marine data user needs, an analysis of the wind, sea surface temperature (SST), wave, ice, chlorophyll, turbidity and current requirements is shown in Figure IV-la. The NOSS goals in Table III-3 are listed in order of decreasing priority (so that, for example, wind data is needed with a higher priority than sea ice data). This priority is borne out by the Worksheet responses with some exceptions. First, marine users in general have a greater need for physical, rather than biological, environmental data. This, in part, is due to the representatives submitting Worksheets, but is believed to be reflective of the overall marine community. Second, needs for ocean current data are essentially as great as needs for ocean wave data, a data requirement indicative of both physical and biological requirements. Third, data requirements for ice have a significantly higher percentage of commercial users (66%) than government users (31%). This may be reflective of offshore facilities design and transportation in regions of sea ice, but this initial analysis does not document such a difference. Fourth, water mass definition was separated into its chlorophyll and turbidity components (SST can also be used for water mass definition) to determine if there is a significant difference in requirements for these two types of data (derived from ocean color measurement). In general, marine users have the least requirement for chlorophyll and turbidity data, with nearly three times the requirement by government representatives as commercial representatives for chlorophyll data. This requirement is believed to be caused by several factors: Only government facilities have had access

Table IV-4. TOPICAL GROUP MODERATORS

	Operational	R&D
Seattle	James E. Overland PMEL	H. Michael Byrne PMEL
La Jolla	R. Michael Laurs PMEL	John W. Sherman, III NESS
Woods Hole	Kenneth Sherman NEFC	Linda Kelly GSA/ADTS
Key Biscayne	Andrew J. Kemmerer SEFC	George Maul AOML
Bay St. Louis	Andrew J. Kemmerer SEFC	John T. Brucks SEFC

Table IV-5. TABULATION OF THE CONFERENCE WORKSHEET RESPONSE TO ORGANIZATIONAL TYPE

(AS OF JUNE 23, 1980)

	Commercial	Academic	Government	Total
	(41)	(32)	(71)	(144)
Government			71	71
R&D	14	14	22	50
Engineering	14	2	1	17
Forecast & Prediction	9	1	9	19
Petroleum	6			6
Other	16	32	3	51
Worksheet Response				
Individual	36	31	64	131
Agency	6	2	12	20
Consortium	5			5
Other			1	1

to ocean color data from which chlorophyll information is derived; other color applications for determination of ocean fronts and other features have not been quantitatively established; and the interest of commercial fisheries may not be well represented in the Worksheets.

The analysis, thus far, has dealt only with user needs that are addressed by the NOSS Program. Dealing only with the planned spatial grid/spatial resolution and temporal resolution (frequency of coverage) stated by the NOSS goals, an estimate of actual NOSS capability to satisfy user requirements is provided. Written comments on the Worksheets revealed that the quality of geophysical measurements was far less a consideration than were grid/spatial and temporal resolutions.

The results of the NOSS spatial and temporal constraints are summarized for three categories of users in Figures IV–1b, –1c and –1d. In these figures the abscissa component labelled "need" is the same as in Figure IV–1a where user needs are compared. However, these remaining figures delineate the ability of NOSS to meet the needs. Thus, the spatial resolution/grid characteristics of NOSS satisfy nearly all commercial users of wind data (94%) but only 60% of the academic[11] and 70% of the government data needs.

Judging of the constraints of temporal resolution of NOSS is based on the actual frequency of coverage cited in Table III–3 of the goals (the frequency in the goal table is for a two–satellite system). Thus, in actuality, the user requirements satisfied by NOSS will be less than those given in these figures. With this limitation in mind, it is readily apparent that the biggest constraint to all users is the frequency of coverage of a satellite system. This constraint is compounded further by the results presented in Appendix D which show that about 30 hours are required for 95% of global coverage. It is noted that two exceptions to this temporal constraint are sea surface temperature and current requirements of the academic community, wherein spatial limitations are more limiting than frequency of coverage.

Often marine users have difficulty in trading off near–synoptic, large–area coverage data with synoptic temporal coverage at limited, discrete data points as collected conventionally. This difficulty is illustrated by present–day applications of satellite–derived sea surface temperature, wherein commercial users estimate that the spatial limitations of NOSS will satisfy 70% of their requirements, but with the temporal limitations, only 21% will be satisfied (Figure IV–1b). This contrasts with the academic users (Figure IV–1c) who have played a major role in developing the application of satellite–derived sea surface temperatures. These academic users are more comfortable with the temporal limitations (because of prior knowledge and experience) than the spatial constraint. However, this form of conclusion is counter to that which might be drawn from the analysis presented in a following section entitled "Prior Satellite Experience and Satellite Data Needs."

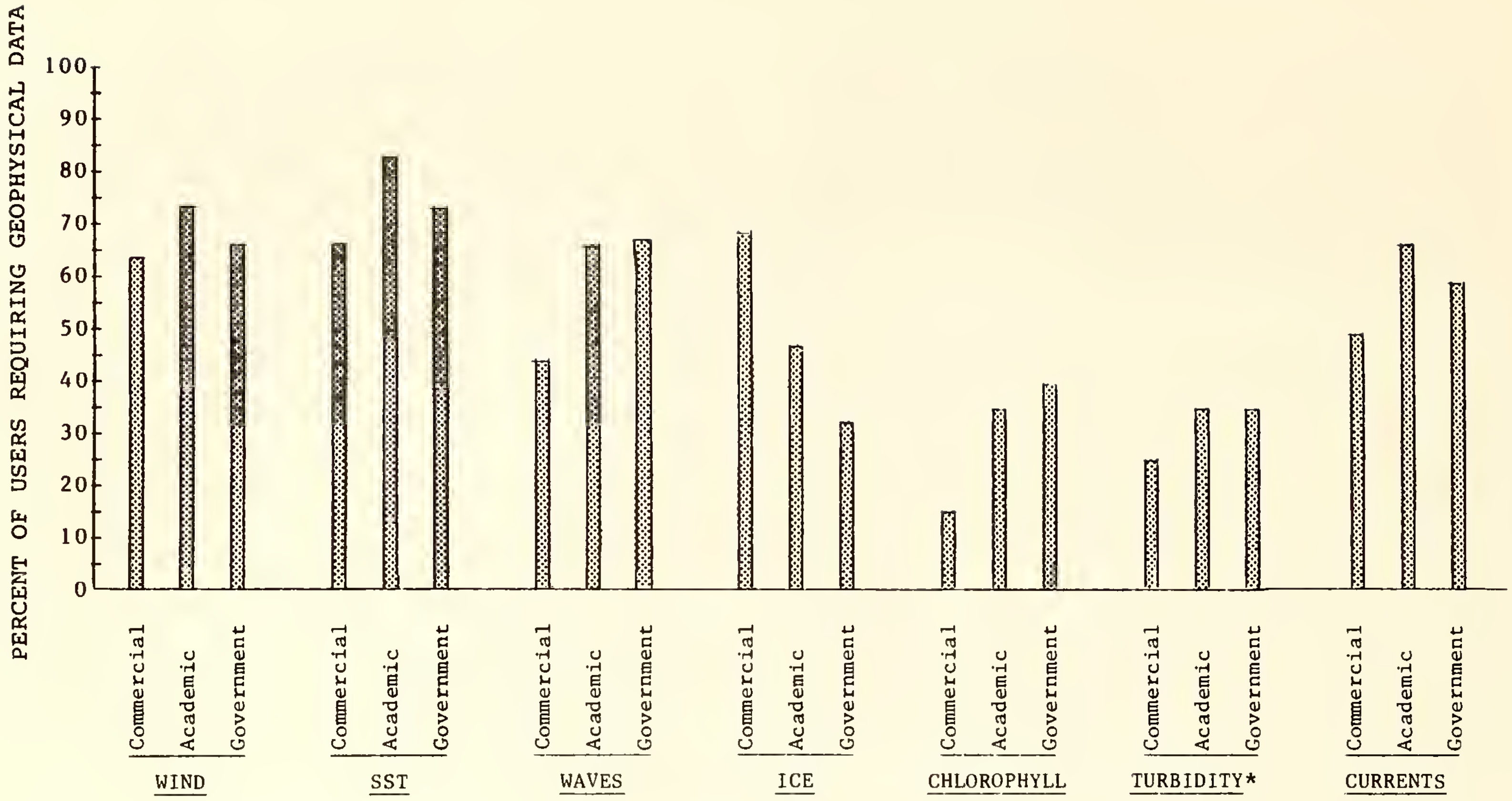
Geophysical Data Delivery Requirements (Question 4)

The delivery time for geophysical marine data, after acquisition by the satellite, falls into two specific categories. The majority of near–real time users, whether commercial, academic or government, want data[12] within three hours as shown in Figure IV–2a. For commercial users, this requirement for three–hour delivery is five times greater than any other category of delivery time.

The non–real time, or retrospective, data users fall largely in the category of those willing to wait four weeks (or longer) for data, as shown in Figure IV–2b. This is believed to be a realistic viewpoint by all users, tempered by how soon the data might be screened and requested by both users and archivists, delivery times, and preparation for data applications by the users.

Area Coverage Requirements (Question 5)

An analysis was made of responses to the basic categories of area coverage data scales proposed in the Worksheet:



* Turbidity is defined to be the diffuse attenuation coefficient.

Figure IV-1a. NORMALIZED COMPARISON OF COMMERCIAL, ACADEMIC AND GOVERNMENT MARINE DATA NEEDS TO BE ADDRESSED BY THE NOSS TRI-AGENCY PROGRAM

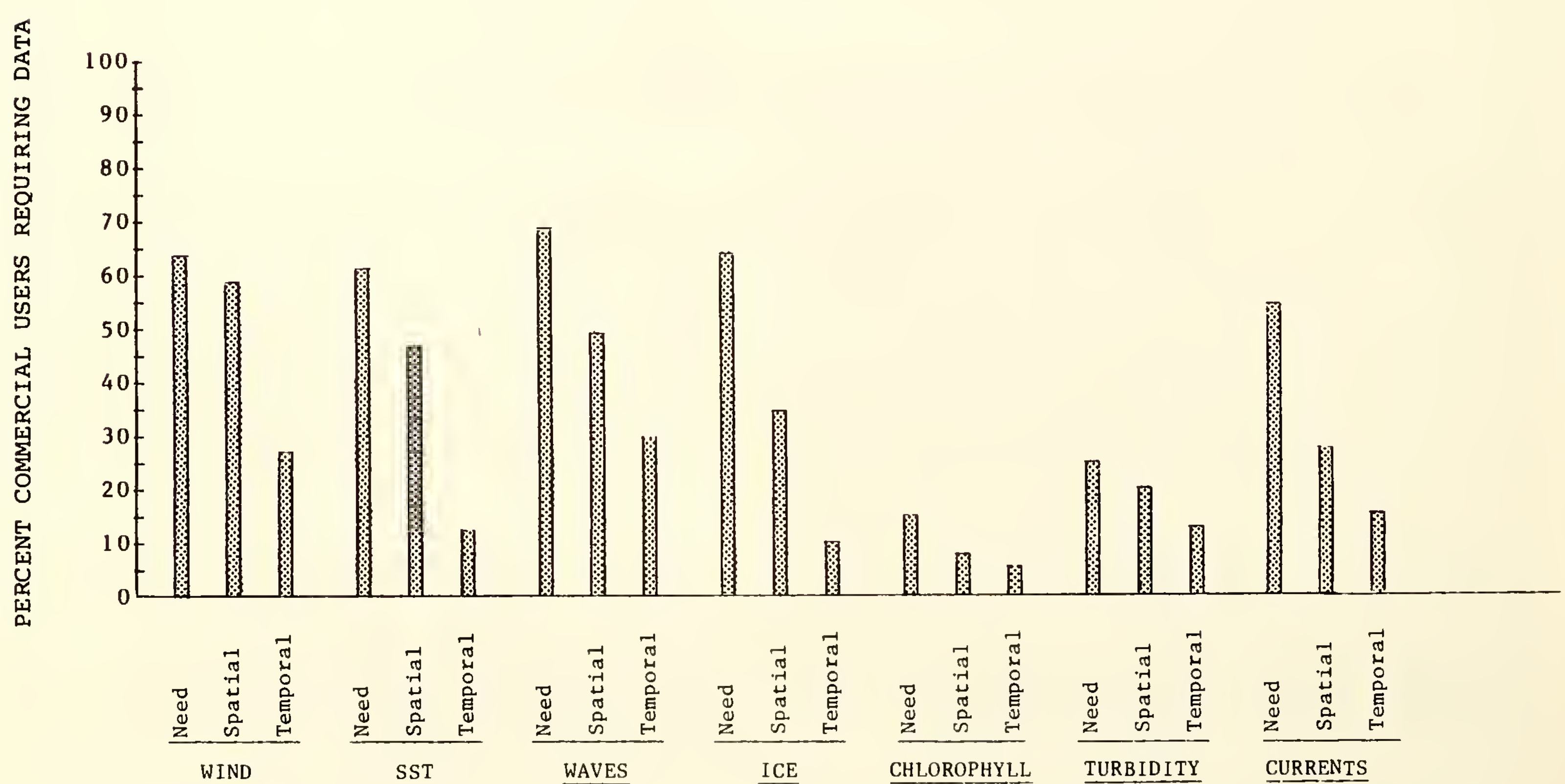


Figure IV-1b. NORMALIZED NOSS DATA REQUIREMENTS FOR COMMERCIAL USERS

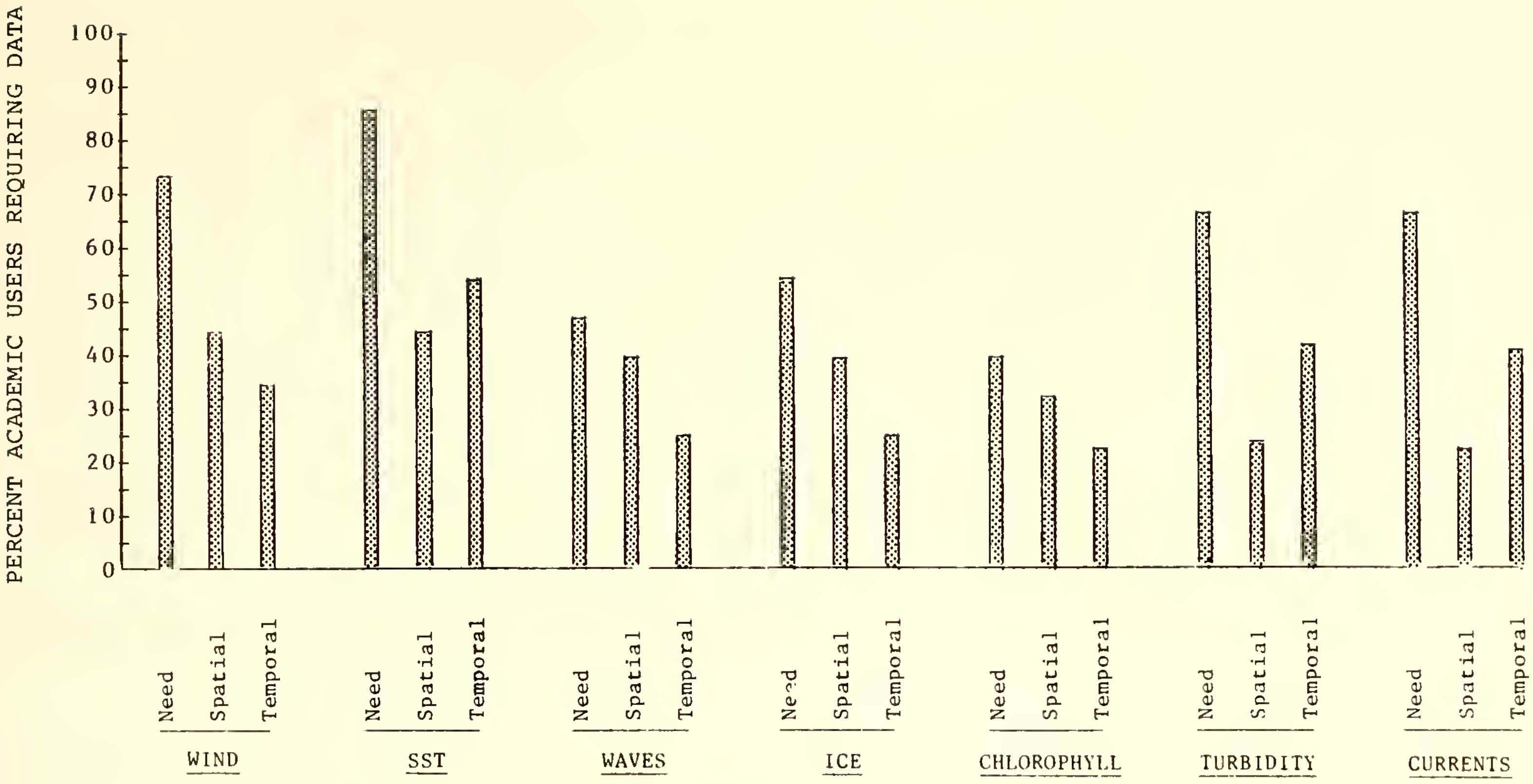


Figure IV-1c. NORMALIZED NOSS DATA REQUIREMENTS FOR ACADEMIC USERS

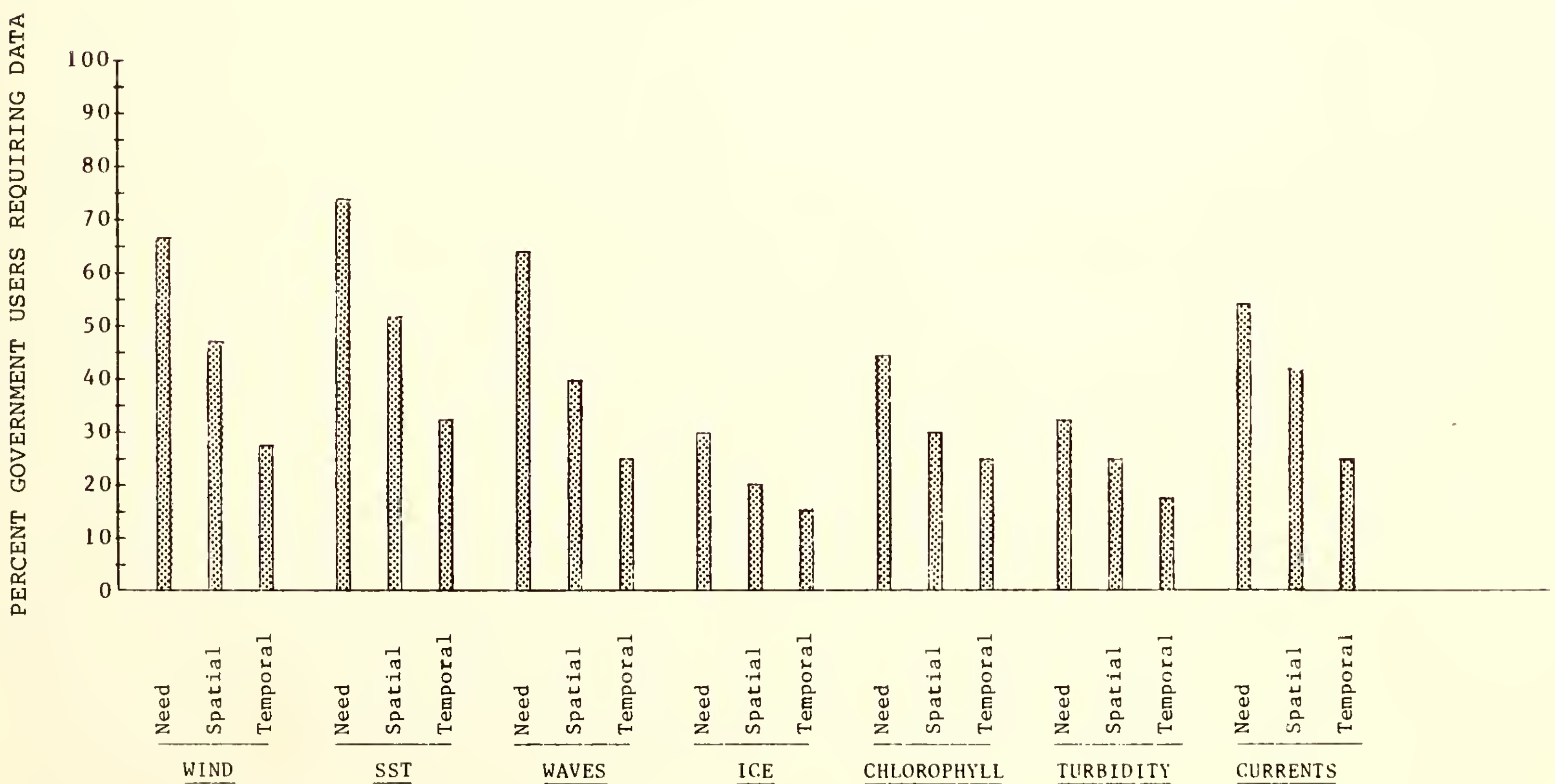


Figure IV-1d. NORMALIZED NOSS DATA REQUIREMENTS FOR GOVERNMENT USERS

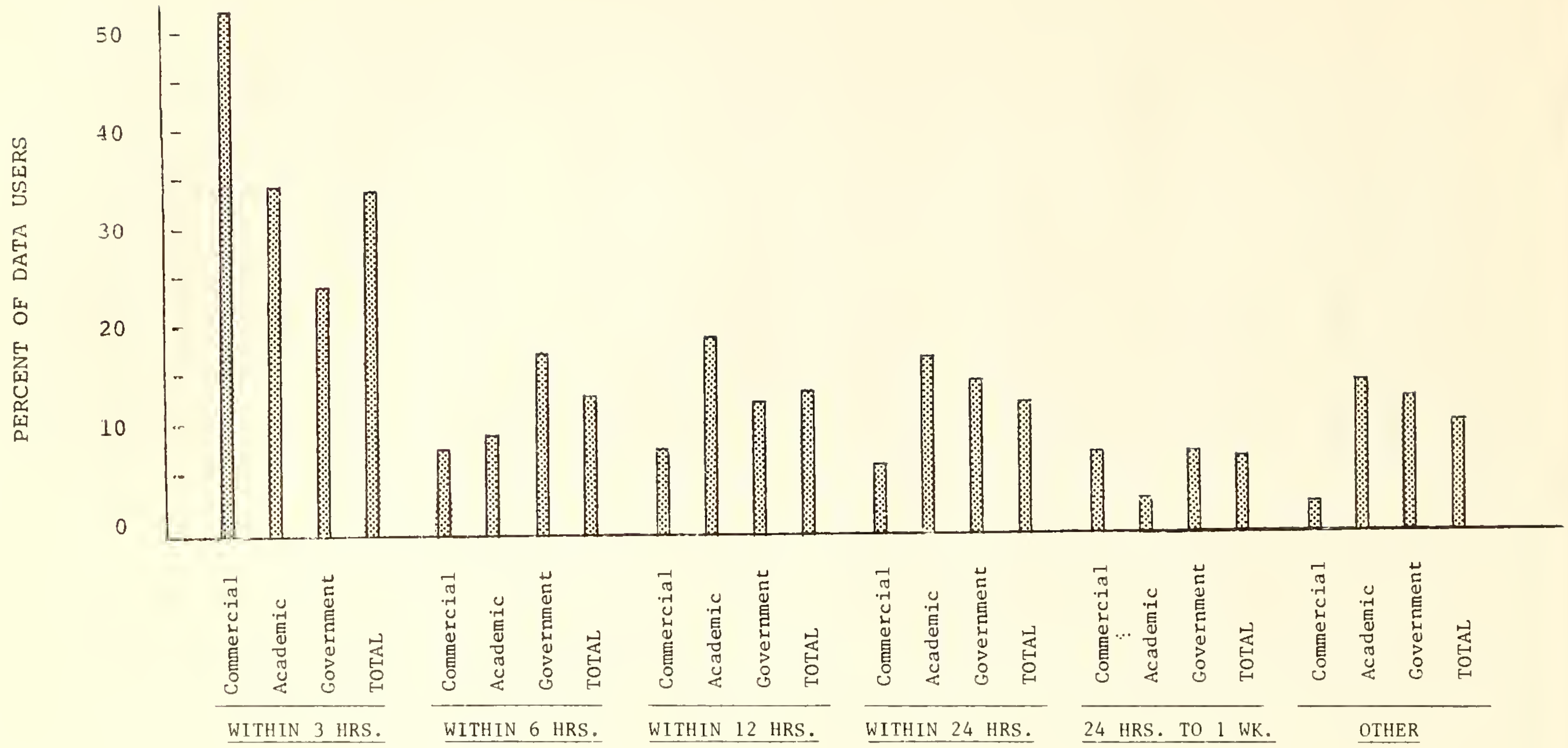


Figure IV-2a. DISTRIBUTION OF NEAR-REAL TIME DATA ACQUISITION REQUIREMENTS

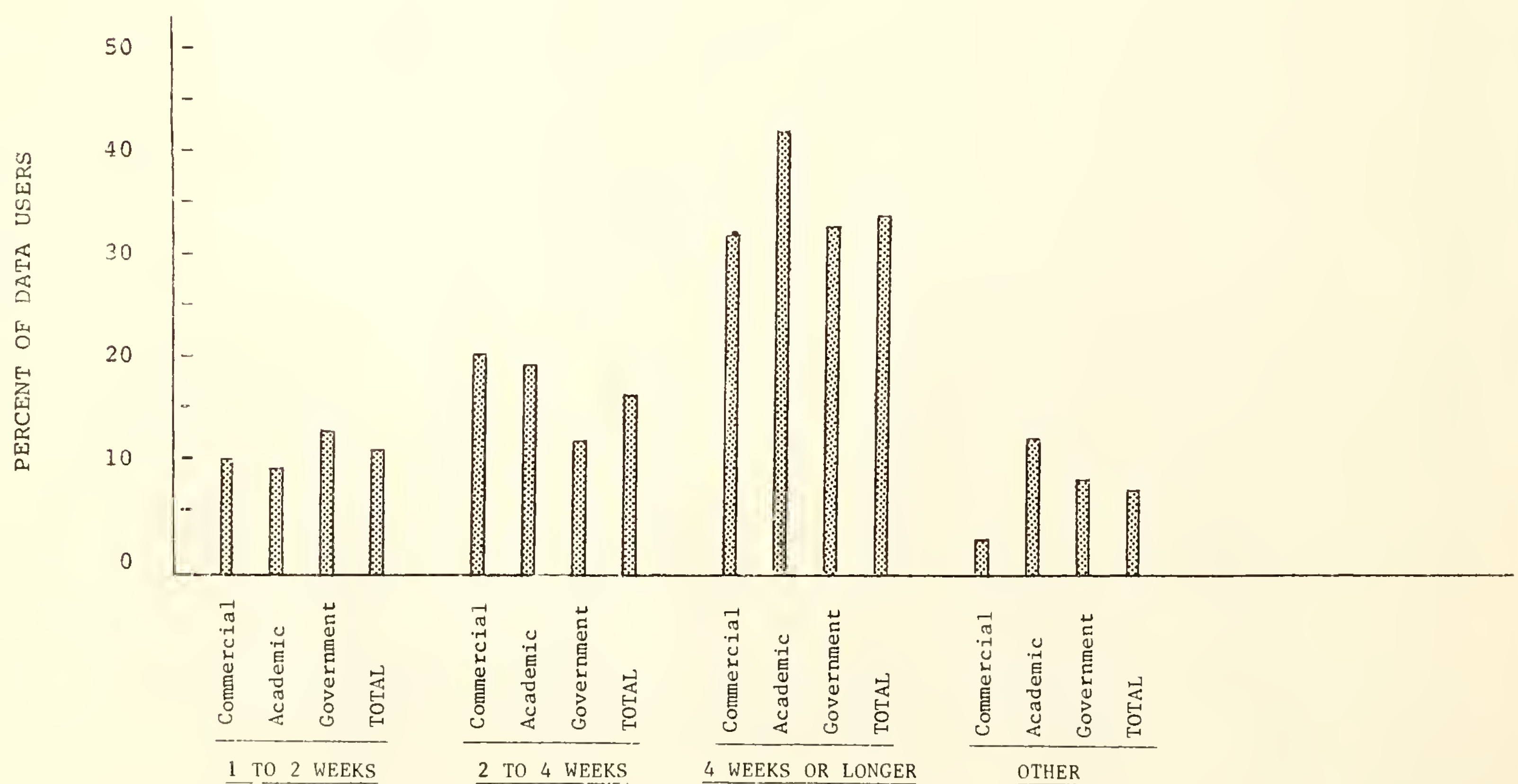


Figure IV-2b. DISTRIBUTION OF NON-REAL TIME DATA ACQUISITION REQUIREMENTS

Local and coastal	(linear dimensions of 100's of kilometers)
Regional	(linear dimensions of 1,000's of kilometers)
Global	(linear dimensions of 10,000's of kilometers)

Further, the analysis also includes whether the anticipated coverage (if less than global) is fixed or varies with time. The results of this analysis are presented in Figure IV-3.

There appear to be no dominant classes of users, so data distribution must be flexible. A point of interest in Figure IV-3 is that government users have the least interest in global data sets as compared to either commercial or academic users.

Data Distribution and Communications (Question 6)

The previous discussions of near-real time and retrospective data requirements, as well as the typical scales for area coverage, influence the capabilities and size of the data distribution system. Inherent in the design of the NOSS data distribution system is the manner in which communication is established between the data source and the user; such a communication link must be mutually established.

Figure IV-4 is the analysis of the Worksheet responses with regard to data communications. Overall, there is no strong preference for any particular type data system (all totals are between 31% and 53%). Commercial users indicate the highest stated need for near-real time dial-in and computer-to-computer data communications (61% and 56%, respectively). Based on the total in each category of communication, the (decreasing) order of priorities is: Near-real time dial-in, near-real time computer-to-computer, computer compatible tapes (CCT's) via mail, photographic products via mail, non-real time computer-to-computer and non-real time dial-in.

Requirements for Engineering Data (Level-I) (Question 7)

The following general definitions are used by the NOSS Program to define data types (from Table III-5):

Level-I	Calibrated, located and time-tagged engineering units
Level-II	Located and time-tagged full resolution geophysical data
Level-III	Value-added geophysical data analysis (grid, contours, etc.)
Level-IV	Forecasts, Predictions, etc.

The designers of the NOSS data distribution system anticipate that there will be similar requirements for Levels-II, -III and -IV data. However, the potential need for Level-I data has not been established. The Worksheet analysis (Figure IV-5) reveals that the need for Level-I is similar to the need for all forms of geophysical data, both in terms of near-real time and retrospective requirements, as well as the spatial and temporal resolutions, data delivery times after acquisition, and area coverage requirements. Twenty-five percent of the academic users indicate requirements for Level-I which differ in data delivery characteristics from geophysical data requirements.

Continuity of Data (Question 8)

The satellite component of the NOSS Program will be collecting oceanic data on a continuous basis. The NOSS data processing facility will be providing Level-II products within three hours after acquisition. Thus, there will be a 24-hour flow of data from the NOSS activity. Many facilities operate on an 8-hour day, 40-hour week basis. If users want the data in near-real time, it will potentially require modification to user facilities/personnel to accommodate data use during non-working hours. The Worksheet analysis of user willingness to incorporate this aspect of NOSS into their planning is shown in Figure IV-6. Less than 10% of the users will operate only during normal working hours with regard to NOSS data.

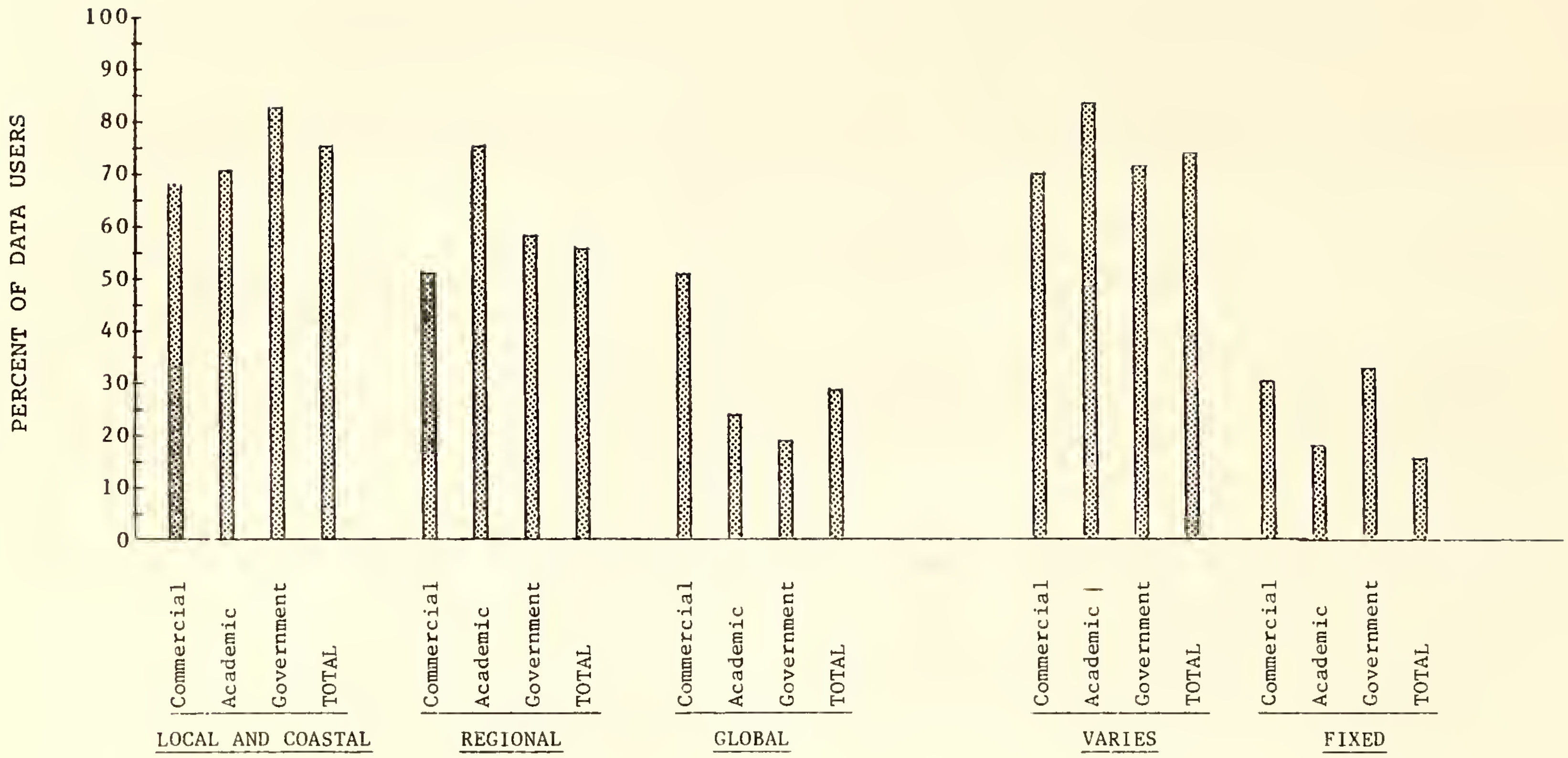


Figure IV-3. ANALYSIS OF SCALES OF COVERAGE FOR MARINE DATA

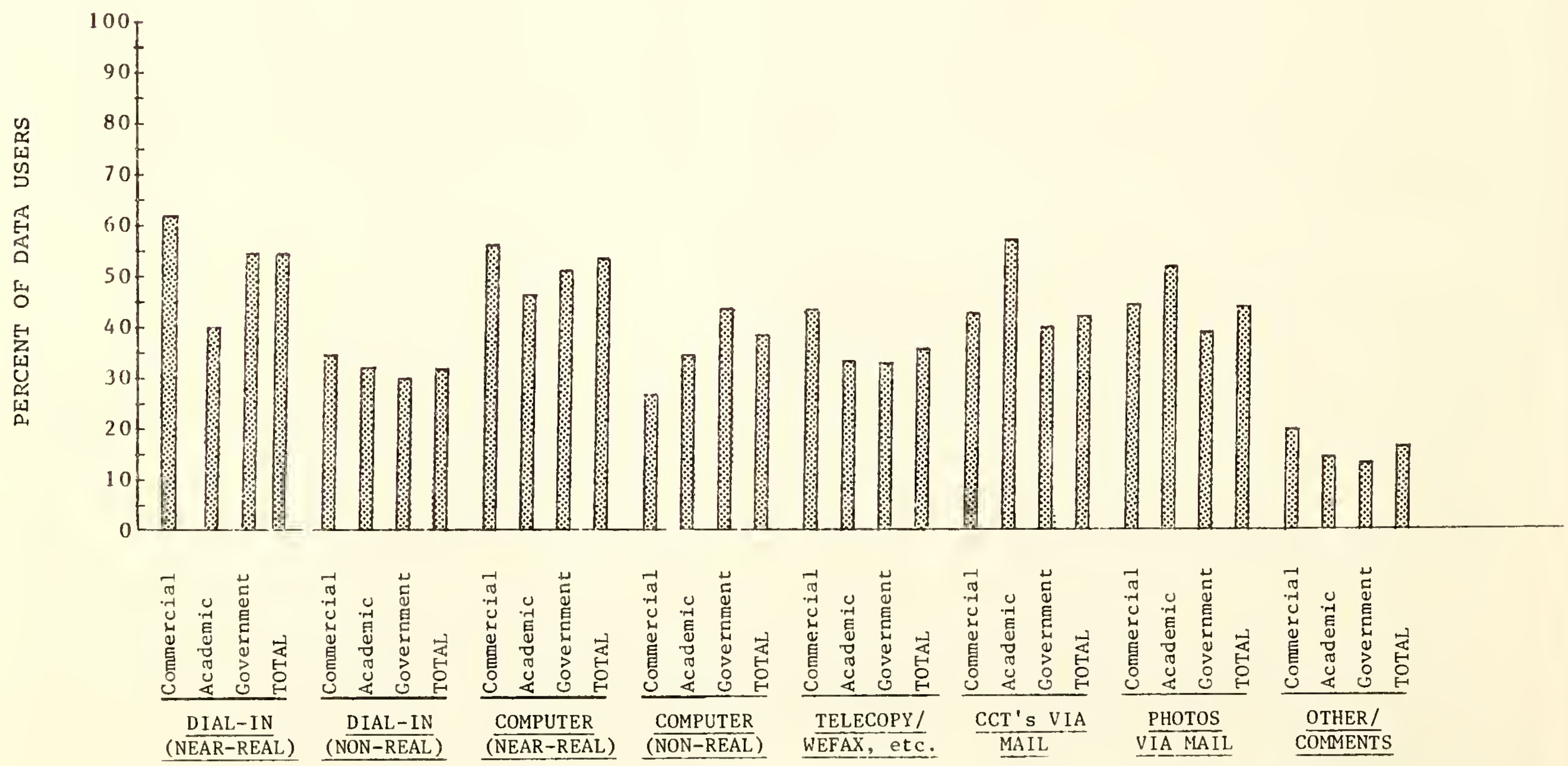


Figure IV-4. ANALYSIS OF NOSS DATA DISTRIBUTION AND COMMUNICATIONS TECHNIQUES

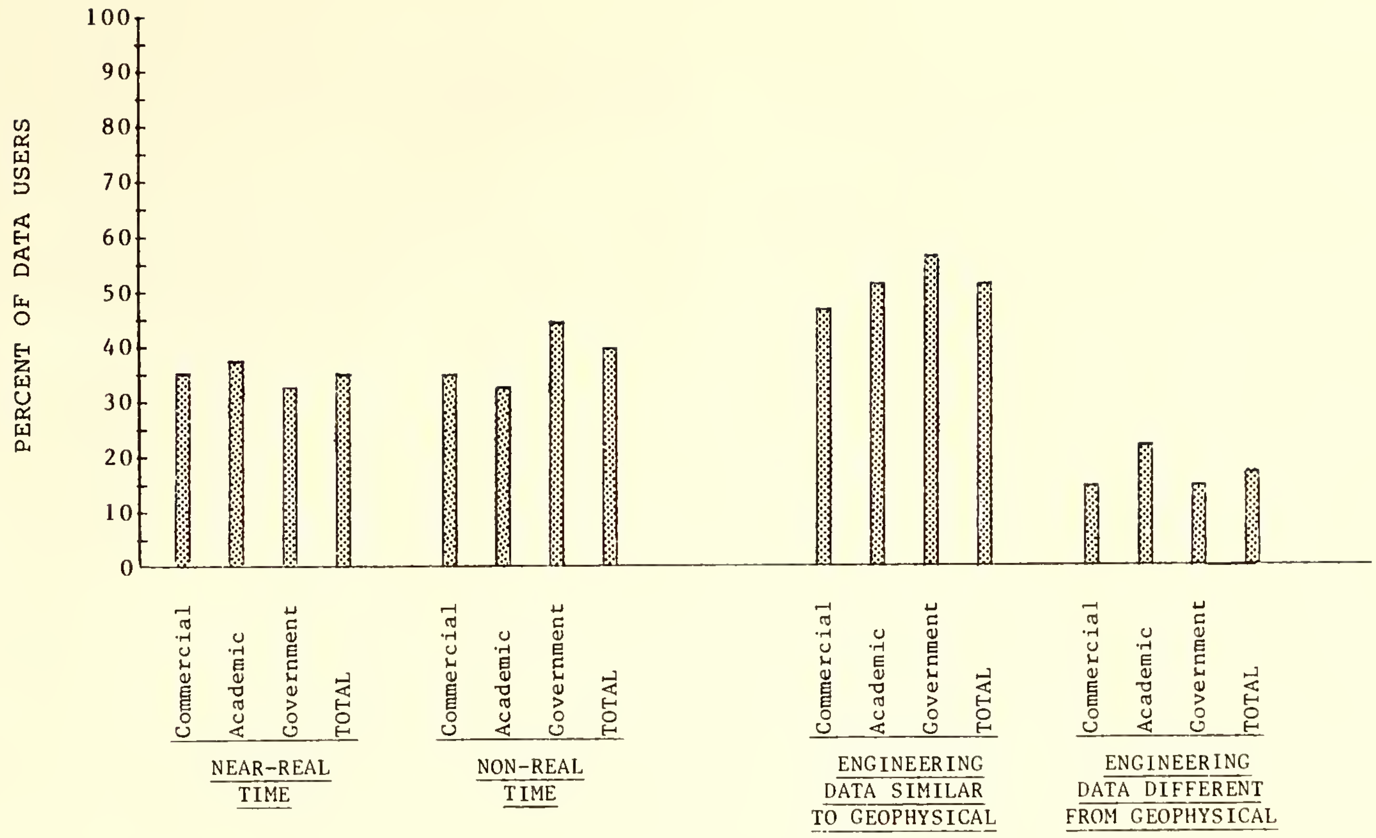


Figure IV-5. ANALYSIS OF ENGINEERING DATA NEEDS AND COMPARISON TO GEOPHYSICAL DATA REQUIREMENTS

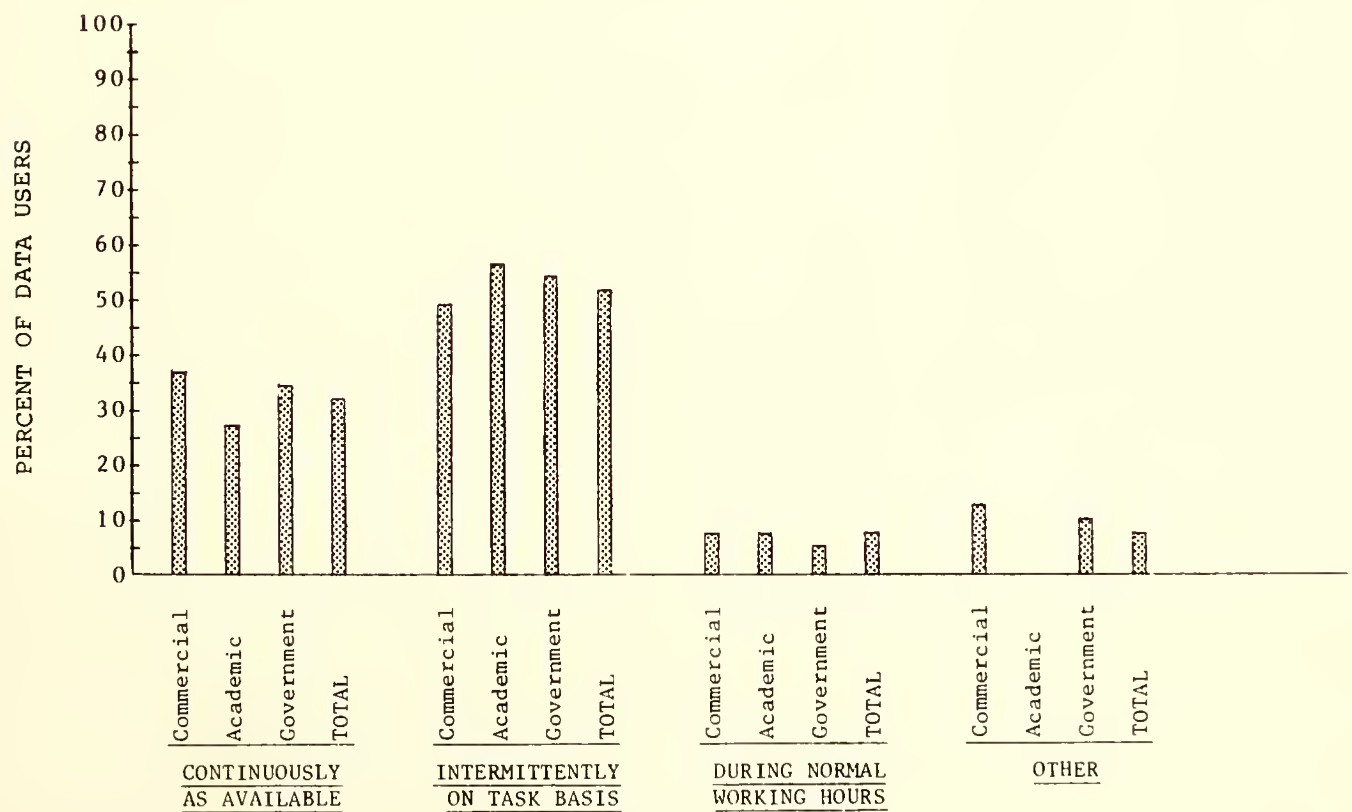


Figure IV-6. CONTINUITY OF NEAR-REAL TIME DATA/ANALYSES NEED

Combining and Merging of NOSS Data with Other Data (Question 9)

The opportunity exists to combine NOSS data with other data sources. For non-real time data, it might be combined with other data sources at Level-II, and for near-real time data, it might be combined with other analyses (Level-III) to provide a merged data set. Such combining and merging would tend to have a "self-validation" built into the geophysical data. The analysis of user needs to provide such combined and merged data sets is shown in Figure IV-7. It is clear that the NOSS data flow to the civilian community requires combined data for retrospective users and both NOSS-merged and NOSS-only data analyses available on a near-real time basis.

Prior Satellite Experience and Satellite Data Needs (Question 10)

Figure IV-8 presents the summary analysis of prior satellite experience by participants who submitted Worksheets. This analysis shows that the users typically have had prior experience with such satellites as GOES, TIROS-N/NOAA, GEOS-3, Seasat or Nimbus-7. The Worksheet format did not seek clarification as to whether the general experience was good or bad; however, an overwhelming majority of users indicated that the availability of these data is useful to their marine needs. Considerably less enthusiastic was the response with regard to potential simulations of data to the NOSS formats wherein the users were about equally divided on its usefulness or non-usefulness.

Awareness of Data Costs (Question 11)

Essentially all potential NOSS data users are aware that they must bear part of the costs associated with duplicating, reproducing or transmitting the data, as shown in the analysis presented in Figure IV-9. In general it appears that as long as the NOSS data costs are consistent with now existing user costs associated with other satellite programs, such as the meteorological and land programs, marine users regard the potential NOSS data cost as reasonable.

Private Enterprise's NOSS Role (Question 12)

The number of comments made by Worksheet respondents on the role of private enterprise in providing information-extraction, value-added services, as well as the responsibilities of government in this area, are as follows:

User Group	Number of Comments Made
Commerce	28 (68%)
Academia	14 (44%)
Government	16 (23%)

The analysis of these comments has not been completed because of their diverse nature. It is obvious that commercial and academic users are more concerned with this subject than government users.

Dialogue and Interface Considerations (Question 13)

A major concern of both the user community and the NOSS Program is the establishment of a mechanism for communication between the marine community and NOAA, as well as the nature of the interface that might be created with academia and commerce. Figure IV-10 illustrates that users most likely will accept any form of communication, but have a preference for the use of on-going publications and continuing the workshop/conference mechanism such as this first series of NOSS Conferences.

The interface consideration between academic and commercial users and NOSS resulted in 46 comments which require further analysis (59% and 68% from the academic and commercial users, respectively, with only 28% from government users). In general, the comments include:

- o Recognition within NOAA that the needed interface is larger than just the NOSS Program or NOSS data;

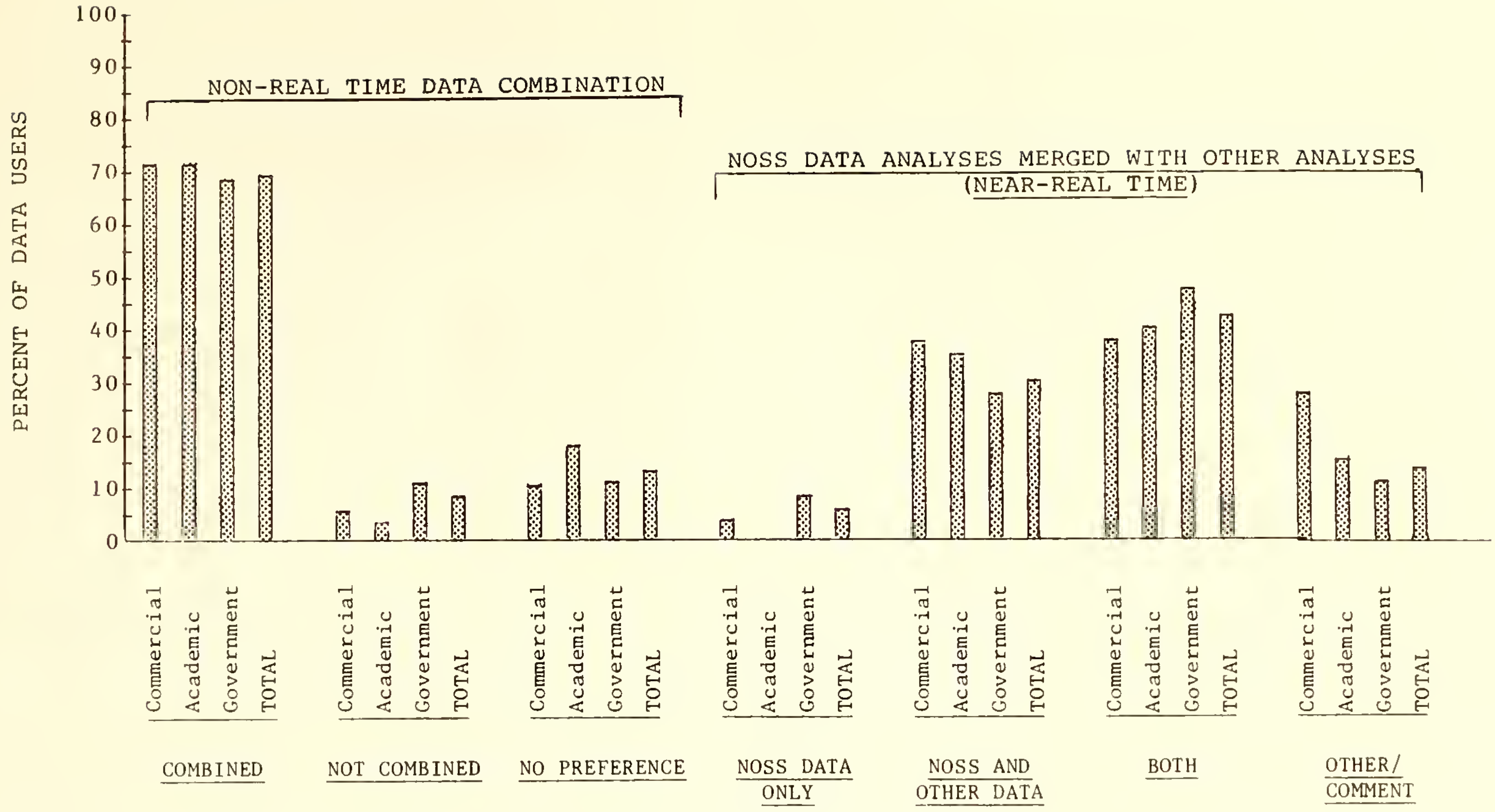


Figure IV-7. ANALYSIS OF COMBINING OR MERGING NOSS DATA WITH OTHER DATA SOURCES

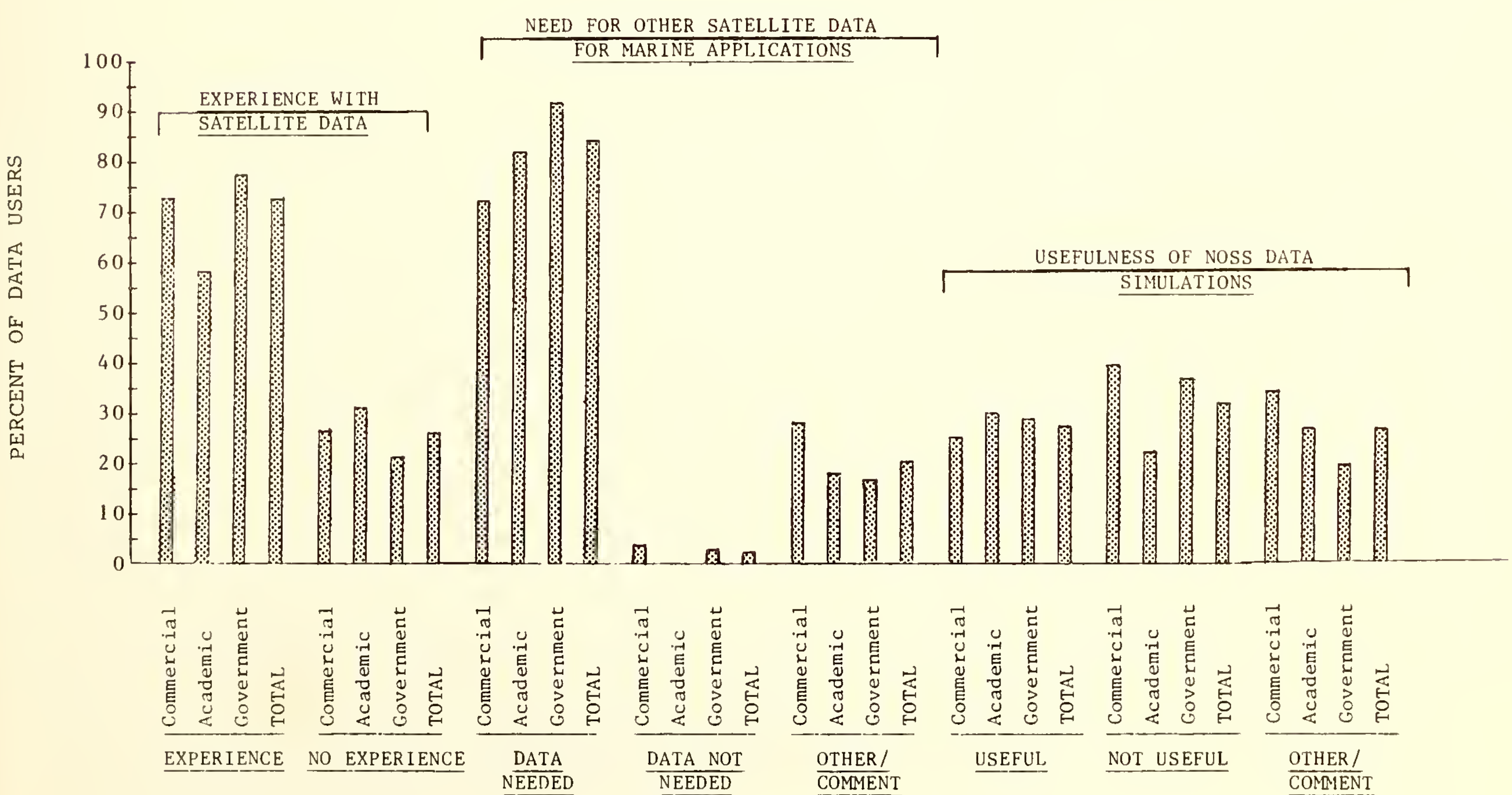


Figure IV-8. EXPERIENCE WITH OTHER SATELLITES AND RELATIONSHIP TO MARINE DATA NEEDS AND NOSS PREPARATION

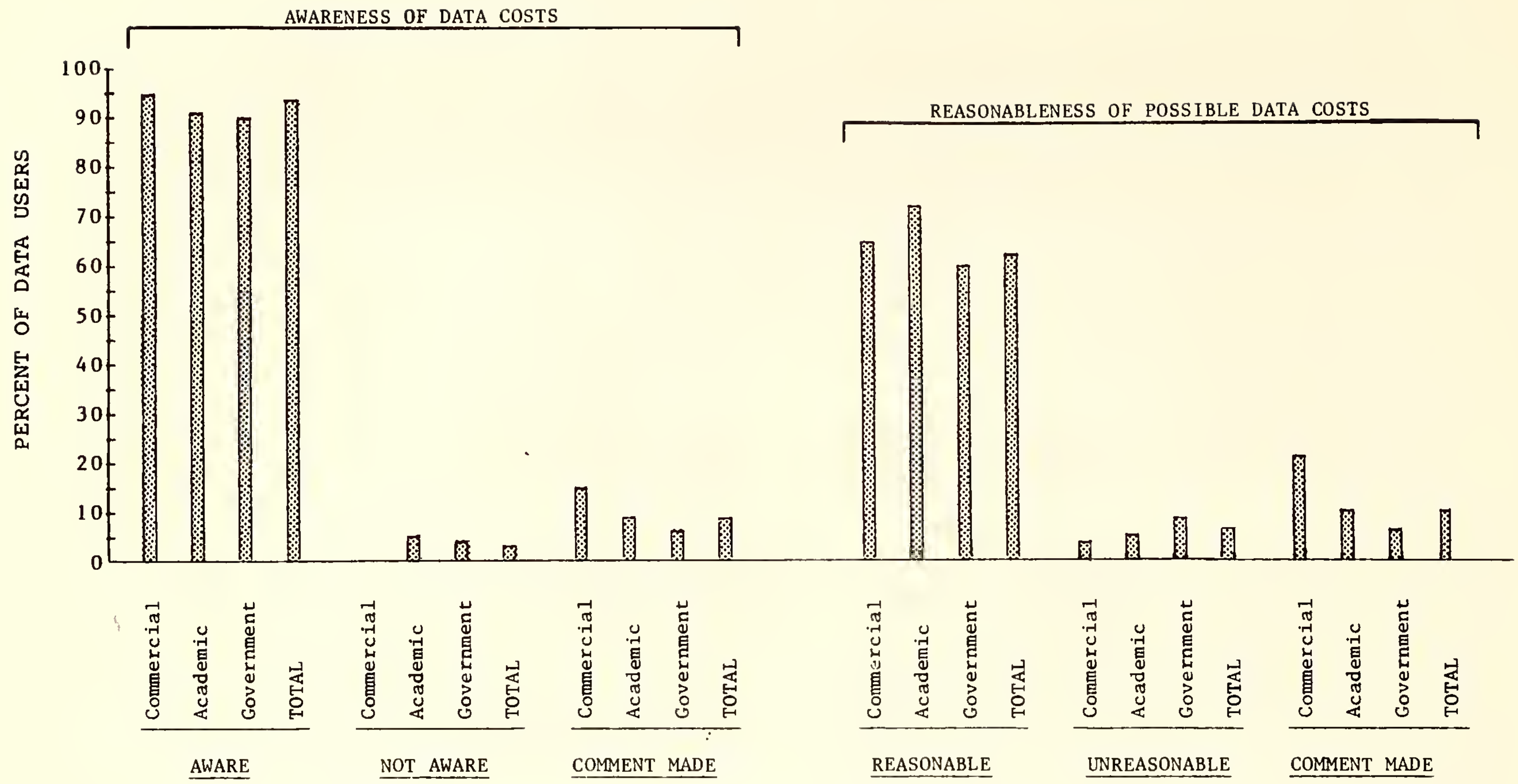


Figure IV-9. ANALYSIS OF DATA COST CONSIDERATIONS

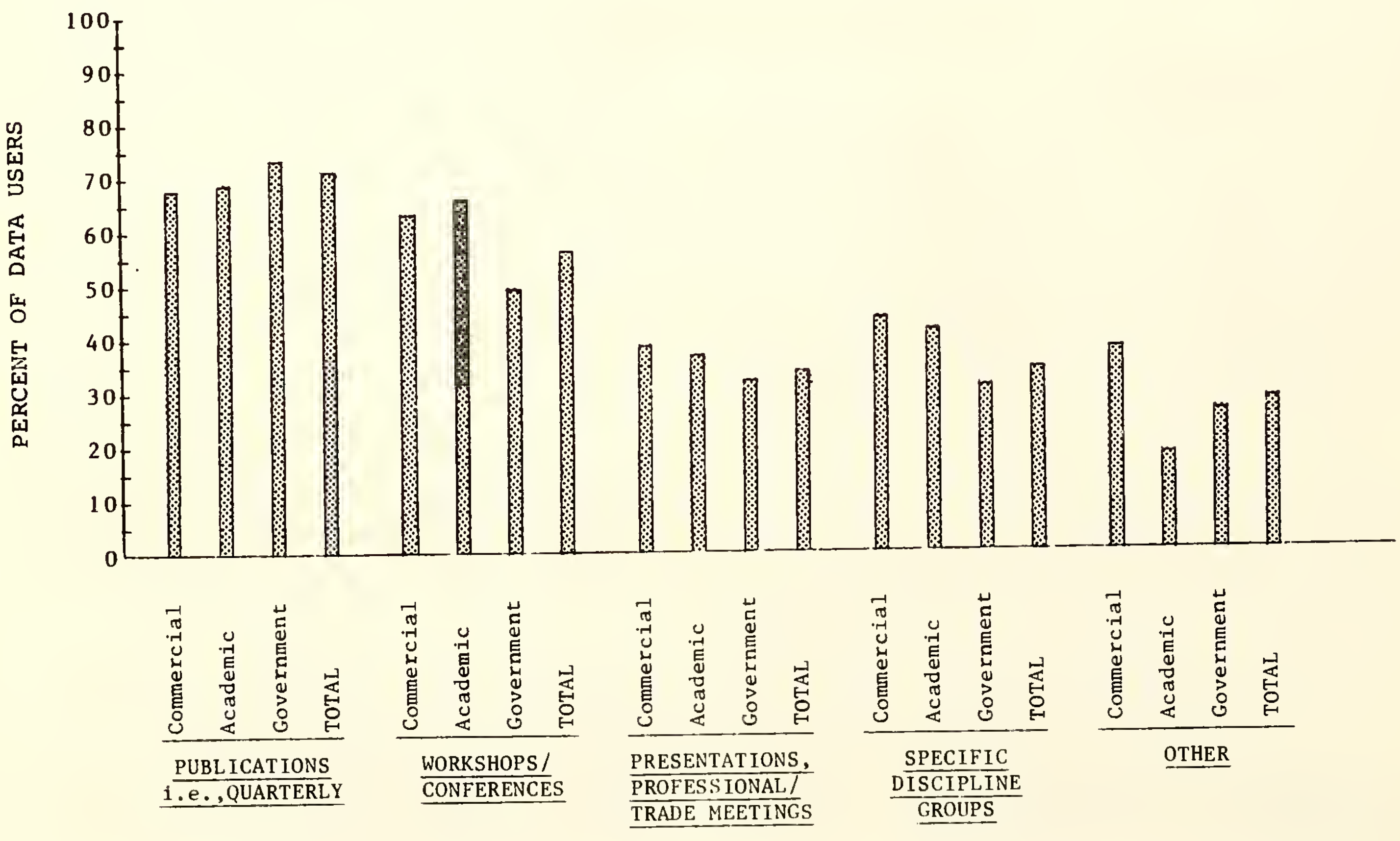


Figure IV-10. ANALYSIS OF MECHANISMS FOR CONTINUING DIALOGUE BETWEEN NOAA/NOSS AND USERS

- The advisory nature of the commercial users' interface needs to be at a management level comparable to the marine R&D advisory activities within NASA; and

- The academic community feels it has a comparable role to play in advising NOAA/NOSS on R&D matters similar to that of the commercial users for applications, and recommends an advisory group be considered.

Other Comments, Suggestions, and Issues (Question 14)

This portion of the Worksheet resulted in a wide range of responses which will be analyzed at a later date. The number of responses are as follows:

User Group	Number of Comments Made
Commerce	25 (61%)
Academic	18 (56%)
Government	30 (42%)

5. Findings and Concerns

The Conference participants' marine data needs are highly compatible with the geophysical goals and priorities for the National Oceanic Satellite System (NOSS). Differences appear to be based on two fundamental elements, the requirements of the biological and physical communities, and the ability of NOSS to address and meet its goals.

The Conference Worksheet response was high, with 144 Worksheets received by June 23, 1980. This represents about a 40% return by the registered participants (or their organizations). The initial analyses of these Worksheets, and the marine data needs represented therein, were completed in the previous section in terms of commercial, academic and government users. These analyses and the Workshop topical group discussions form the basis for the findings and concerns.

It is emphasized that these findings and concerns are based on the Conference results, and are not necessarily the findings and concerns of the tri-agency NOSS Program, NASA, NOAA, Navy nor any other Federal agency. They are published to document the Conference and further the dialogue between civil marine data users and NOAA, as the lead agency for the civil marine community.

The findings and concerns are presented in six categories: Data and Data Telemetry, Processing and Training, Dialogue and Communications Mechanisms, Validation, Support to R&D and Other.

Data & Data Telemetry

General

- High correlation exists between NOSS data goals and priorities and civil marine community needs.

- Easy access to and retrievability of data is paramount to NOSS data use.

- Flexibility and compatibility to combine and merge both data sets and analyses are necessary (if not done routinely by the NOAA Oceanic Data System).

- A high interest exists in currently and potentially available marine products, such that a NOAA marine data distribution system should not necessarily wait for the operational demonstration satellite component of NOSS.

- There is a strong need for sea-going vessels to receive full-resolution NOSS products (winds, waves, ice. temperature, chlorophyll and currents).

- There is concern about the possible "dumping" of data from the archive without alerting retrospective data users.

- Two forms of concern exist on protection of NOSS data: First is the criteria and conditions by which data will be denied; and second is the subsequent availability of such protected data on a retrospective basis.

Specific

- When spatial grid and spatial resolution characteristics of NOSS are evaluated by the users, there is a slight reduction in the utility of NOSS data.
- When temporal coverage characteristics of NOSS are evaluated, there is a reduction in NOSS data capability that needs further evaluation.
- Near-real time data should be delivered to users within 3 hours after acquisition.
- Retrospective data, or non-real time data, can have delivery times on the order of 4 weeks to meet the demands of most users.
- The coverage areas for NOSS data will be changed from time to time for the majority of users.
- There is no significant preference among users for local, regional or global data.
- There is no preference for the type data distribution system for communication of data to users. Needed are dial-in, computer-to-computer, Wefax, photographic products, etc.
- Engineering data requirements appear to be almost identical to the geophysical data requirements.
- Most users want to receive NOSS near-real time data on a continuing basis and will modify facilities/personnel to accommodate such data on an around-the-clock basis.
- Users will want retrospective geophysical data merged with other forms of marine data.
- Users will want near-real time data analyses available in both NOSS-only and NOSS-merged configurations.
- A large percentage (70%) of marine data users have had some form of satellite data experience.

Processing and Training Center

- A central or regional data processing facility is needed for pre-launch training and for R&D post-launch use.
- Training of users with current satellite data is desirable as a preamble to NOSS preparation of the marine data users.
- Audio-visual cassettes for specific users of NOSS data should be prepared for direct use at docks, etc., by many end users. The Sea Grant College Program might be the appropriate vehicle for this form of training.

Dialogue and Communications Mechanism

- A focused NOAA environmental service for users is desired rather than the individual services of NOAA's Major Program Elements. NOSS should not become yet another stand-alone service.
- Newsletters, bulletins, etc., are highly useful at a periodical frequency appropriate to NOSS developments and changes. Such techniques for correspondence should include a

format to accommodate articles by users, be they academic, commercial or other government (non-NOAA) NOSS participants.

- Audio-visual cassettes for communications of basic capabilities would serve a large segment of users who are unable to attend formally structured meetings.

- Publications and presentations in professional literature and meetings along with other special NOSS conferences appear to be the two better methods for a continuing dialogue with the general marine community.

- Users in the commercial sector wish to serve in a senior advisory capacity to NOAA on NOSS matters, and the R&D community also feels it has an advisory role to both NASA and NOAA.

Validation

- Many users need a continuing assessment throughout the life-time of NOSS of the estimated accuracy of the geophysical data.

- Availability of Nimbus-7 CZCS and SMMR data in conjunction with on-going marine experiments would significantly enhance the NOSS statements on capabilities and validity of satellite-derived data.

- Major attention to intra-callibration of comparative data sets (sea truth) is needed as a part of the validation program.

- True validation of NOSS data, as an end-to-end data system, can only be achieved by end users and, as such, specific representative users should be included (and funded) as an inherent portion of the validation effort.

- Estimates on actual improvement of marine weather forecast/prediction would enhance the involvement and support of a large segment of the commercial sector.

Support to R&D

- There is a major need to establish support activities to permit the science elements to do specific investigations instead of computer investigations within the tri-agency NOSS Program.

- A national-type facility for the interactive processing of NOSS data is a high priority requirement among R&D users.

- A concern exists for NASA to define quickly the 25% R&D growth opportunities for science within the NOSS Program. Joint collaboration between NASA (as lead R&D agency) and NOAA (long-term applications) has been suggested.

- R&D users would prefer a mechanism by which to influence NOAA/NOSS science activities and not depend solely on NASA.

Other

- Present-day transmissions to fishing vessels on the U.S. west coast appear to be ahead of those on the east coast.

- Tracking of marine mammals remains a very important requirement for specific governmental activities.

- Many potential users feel a significant limitation in defining their specific NOSS data requirements in the absence of any "hands-on" use of such data.

- Further questions and resulting

answers on data and data requirements will be possible as a result of the first series of Conferences since both NOSS planners and NOSS users are more informed on mutual problems and concerns.

o Before the commercial sector (and others) invest in the five-year demonstration program, assurances and commitments on capabilities and products continuation after the initial NOSS phase are required.

[6] Now known as NOAA Oceanic Data System.

[7] The Bay St. Louis Conference contained a third topical group meeting for DoD/Navy NOSS Planning, conducted by OPNAV, U.S. Navy.

[8] Actually 432 persons registered, including 14 conference presenters and managers. Excluding site chairs, presenters and moderators, 365 individuals participated. There were 30 "no-shows".

[9] It is not intended to imply that vessel-at-sea data reception is necessarily a NOSS program responsibility, only that it needs major improvement via modern technology if NOSS is to realize its full potential.

[10] Thus, if 17 out of 31 private Worksheet responses needed a specific data type, then 55 % of this group required the data. If 17 out of the 71 government Worksheet responses required these same data, then the percentage is 24 %.

[11] These percentages were determined by dividing the percentage of users satisfied by the spatial characteristics for a given parameter, i.e., wind, by the percentage needing that type of data. Thus, for commercial wind users, 59 ÷ 63 x 100 % = 94 %.

[12] The "total" column shown in this and the remaining analysis figures is the fraction of users in the given criterion divided by all users (i.e., 144) submitting Worksheets (multiplied by 100 for percentage). This total is not the average of the three categories of users.

V. ON CONTINUING A DIALOGUE

The first five NOSS Conferences were developed to involve the civil marine community in specifying requirements for NOSS-types of data and products, to determine the commonality of these data among all users and to design a data distribution system consistent with the requirements and commonality. The Conferences represent a beginning, not a conclusion, of activity. As such, a summary and conclusion are not appropriate to this Report. The Report itself will be used as a vehicle for communication between NOSS designers and the marine community. Thus, comments on the Report itself and the accuracy with which it reflects the Conference proceedings are encouraged.

Furthermore, the Report has been prepared to reflect the content of the Conferences so that non-participants in these five meetings can become involved in the data planning aspects of NOSS. The Worksheet in Appendix B can be submitted in accordance with the accompanying instructions.

The forms by which the dialogue may be continued have been cited in the previous chapter. In summary, these include publication of special newsletters or bulletins on a periodic basis, publication in professional journals and trade magazines, inclusion of user viewpoints to be shared in these same publications, establishment of advisory group(s) to NOAA for non-Federal users and future conferences held on a periodic basis.

Those users associated with operational needs and requirements strongly favor a NOSS advisory group to NOAA to provide senior level input and guidance. It should be noted here that any committee, board, commission, council, conference, panel, task force or other similar group or subgroup thereof, which is established or utilized by one or more Federal agencies in the interest of obtaining advice or recommendations, is an advisory committee within the definition of the Federal Advisory Committee Act (FACA), P.L. 92-463, as amended. Any new committee must be (1) sanctioned by its establishment in legislation; (2) specifically authorized by the President; or (3) determined, as a matter of formal record, by the head of the agency involved after consultation with the Director (Office of Management and Budget), with timely notice published in the Federal Register, to be in the public interest in connection with the performance of duties imposed on the agency by law. No advisory committee shall meet or take any action until a charter has been filed with the head of the agency to whom the committee reports and with the congressional committees having legislative jurisdiction.

NOAA management will review and pursue those options that will best fulfill the needs of oceanic users and NOAA. However, NOAA will not act independently of the mechanisms by which a dialogue is continued with the land-oriented user community. Thus, it is anticipated that conferences, workshops and advisory committee(s) will be maintained or established for oceanic data users.

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APPENDIX B

CONFERENCE WORKSHEET AND STATISTICAL SUMMARY

1. Worksheet

The following Worksheet was used to facilitate discussion of the NOSS data requirements. Other marine data users who did not attend the Conferences but would like to provide a similar input, can duplicate this Worksheet and forward it to:

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2. Statistical Summary

The summary of the first 144 Worksheet responses is tabulated for anyone desiring to perform additional analyses (Figures B-1. to B-3.). Results of such analyses would be appreciated if mailed to the address cited above.

NOSS CONFERENCE WORKSHEET

1. BACKGROUND INFORMATION (OPTIONAL)

NAME ______________________________

ORGANIZATIONAL AFFILIATION ______________________________

ADDRESS ______________________________

____

______________________________ ZIP ______________

PHONE Area Code ( ) ______________________________

- -

2. TYPE ORGANIZATION

☐ Government (federal, state or local)
☐ R&D
☐ Engineering
☐ Forecast/Prediction Services
☐ Petroleum related
☐ Other (please specify) ______________________________

Major responsibilities ______________________________

____

The response to this worksheet represents:

☐ Individual professional judgment
☐ Agency/Organization position
☐ Consortium position (If Consortium, please specify type Consortium and identify if members have responded in either of the first two categories)

Type ______________________________ Category ______________

☐ Other ______________________________

3. WHAT OCEANIC MEASUREMENTS ARE REQUIRED TO SUPPORT YOUR ACTIVITY AND ON WHAT GRID OR RESOLUTION?

	Spatial Grid	Temporal Resolution
Wind velocity		
Wave height/direction		
Sea surface temperature		
Sea ice measurement		
Ocean current velocity		
Chlorophyll		
Diffuse attenuation coefficient/ turbidity		
Other		

4. AFTER SATELLITE DATA ACQUISITION, DATA IS REQUIRED IN

- ☐ Near-real time
  - ☐ within 3 hours
  - ☐ within 6 hours
  - ☐ within 12 hours
  - ☐ within 24 hours
  - ☐ 24 hours to 1 week
  - ☐ other
- ☐ Non-real time
  - ☐ 1 to 2 weeks
  - ☐ 2 to 4 weeks
  - ☐ 4 weeks or longer
  - ☐ other

5. DATA IS REQUIRED OVER SCALES OF

☐ Local and coastal	(100's of kilometers)
☐ Regional	(1,000's of kilometers)
☐ Global	(10,000's of kilometers)

Does your coverage vary or remain fixed?

☐ Varies ☐ Fixed

6. DATA FROM NOSS MUST BE DISTRIBUTED TO USERS. HOW BEST SHOULD SUCH COMMUNICATIONS BE ESTABLISHED?

- ☐ Dial-In Techniques (near-real time)
- ☐ Dial-In Techniques (non-real time)
- ☐ Computer-to-computer (near-real time)
- ☐ Computer-to-computer (non-real time)
- ☐ Telecopy/Wefax, etc.
- ☐ CCTS (from archive) via mail
- ☐ Photographic products via mail
- ☐ Other/Comment ______________________________

____

7. GEOPHYSICAL DATA WILL PROBABLY BE THE MOST COMMON FORM OF NOSS DATA. HOWEVER, CALIBRATED, LOCATED, ENGINEERING DATA (LEVEL 1) WILL BE POTENTIALLY AVAILABLE TO USERS.

Do you need these data in: ☐ Near-real time ☐ Non-real time

Are the requirements for Level 1 the same as for questions 3, 4, and 5?

☐ Yes ☐ No

If No, please comment on differences.

____

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____

8. DOES NEAR-REAL TIME DATA/ANALYSES NEED TO BE RECEIVED

☐ Continuously as available; ☐ Only during normal working hours;

☐ Only intermittently on a task basis; ☐ Other ______________________________

____

____

9. IF POSSIBLE WOULD IT BE OF BENEFIT TO COMBINE NOSS GEOPHYSICAL MEASUREMENTS WITH OTHER GEOPHYSICAL DATA SOURCES FOR NON-REAL TIME DATA?

☐ Yes ☐ No ☐ No preference

The NOSS data distribution system will have the capability of producing analyses of oceanic parameters from NOSS data merged with other analyses. Will you be accessing:

☐ NOSS data only
☐ NOSS and other data
☐ Both
☐ Other/Comment ______________________________

____

____

10. HAVE YOU USED ANY DATA FROM GOES, TIROS-N/NOAA, GEOS-3, SEASAT OR NIMBUS-7 SATELLITES?

☐ Yes ☐ No

Would the availability of these data be useful?

☐ Yes ☐ No ☐ Other/Comment ______________

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____

____

Would reprocessing of these data to the NOSS Formats be useful? (Note: a time delay of a year or more may be required)

☐ Yes ☐ No ☐ Other/Comment ______________

____

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11. ARE YOU AWARE THAT CERTAIN DATA COSTS MAY BE BORNE BY YOU AS A USER (TERMINAL INTERFACE, COMMUNICATION LINKS, ETC.)?

☐ Yes ☐ No ☐ Comment ____________________

For non-real time users current CCT's cost is about $60.00 and photographic products vary according to type, size, etc. Do you find these costs a reasonable basis for NOSS data charges?

☐ Yes ☐ No ☐ Comment ____________________

12. WHAT SHOULD BE THE ROLE OF PRIVATE ENTERPRISE IN PROVIDING INFORMATION-EXTRACTION VALUE-ADDED SERVICES TO SATISFY YOUR CONTINUING INFORMATION REQUIREMENTS? WHAT CAN THE FEDERAL GOVERNMENT DO TO ASSURE THE SUCCESS OF THIS ROLE?

13.a. DO YOU HAVE COMMENT ON HOW BEST TO CONTINUE A DIALOGUE BETWEEN NOAA/NOSS AND USERS?

- ☐ Publications, i.e. quarterly
- ☐ Workshops/Conferences
- ☐ Presentations at professional/trade meetings
- ☐ Establish specific discipline groups
- ☐ Other ______________________________

____

b. Do you have any suggestions on how best to organize the interface between private sector (academic and industrial) and NOAA?

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14. OTHER COMMENTS, SUGGESTIONS, ISSUES.

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____

Conference Managers:

HRM, Inc.
1101 30th Street N.W., Suite 301
Washington, D.C. 20007

(202) 338-9071

5/15/80

I.D. Number	2: Government	2: R & D	2: Engineering	2: Forecast/Pred.	2: Petroleum	2: Other	2: Individual	2: Agency	2: Consortium	2: Other	4: < 3 hrs.	4: 6 hrs.	4: 12 hrs.	4: 24 hrs.	4: > 24 hrs. - 1 wk.	4: Other	4: 1-2 wks.	4: 2-4 wks.	4: > 4 wks.	4: Other
001		X		X			X				X									
002						X	X							X				X		
003		X					X								X		X			
004		X					X								X					
005		X					X												X	
006		X					X												X	
007			X				X				X								X	
008			X			X	X				X						X			
009			X				X											X		
010			X				X	X			X							X	X	
011			X				X				X								X	
012			X				X													
013			X				X						X					X	X	
014					X		X												X	
015		X	X				X				X									
016		X	X			X	X						X				X			
017				X		X		X			X									
018		X	X		X	X	X					X							X	
019		X		X			X							X			X			
020		X		X			X											X		
021		X			X		X				X								X	
022						X	X													
023						X		X			X									
024						X	X													
025						X	X									✓				
026						X	X								X					
027						X	X				X									
028		X	X		X		X				X							X		
029						X	X				X								X	
030				X					X		X								X	
031					X			X				X								
032					X		X					X								X
033		X		X			X				X									
034				X			X		X		X									
035						X	X				X								X	
036			X				X	X			X								X	
037				X			X		X		X							X		
038			X	X			X				X									
039						X			X		X									
040						X	X	X	X		X									
041		X	X			X	X						X					X		

I.D. Number	5: Local/Coastal	5: Regional	5: Global	5: Varies	5: Fixed	6: Dial/Nearreal	6: Dial/Nonreal	6: Comp/Nearreal	6: Comp/Nonreal	6: Telecopy	6: CCTS/Mail	6: Photo/Mail	6: Other	7: Nearreal	7: Nonreal	7: Yes	7: No
001	X			X		X		X						X		X	
002	X	X		X		X		X			X	X		X		X	
003	X				X		X			X		X					
004	X			X											X	X	
005			X	X			X					X			X	X	
006	X		X	X							X	X			X	X	
007	X				X	X	X	X	X	X	X	X	X	X		X	
008	X	X		X		X	X	X	X	X		X	X		X	X	
009			X		X										X	X	
010	X	X	X	X		X	X	X		X	X	X		X		X	
011	X			X		X					X	X					
012								X			X	X					
013	X	X	X	X		X	X	X	X						X		
014	X					X	X	X	X	X	X	X			X		
015		X	X	X				X							X		X
016	X	X		X					X		X	X					
017			X		X	X		X									
018	X	X		X		X	X	X	X	X	X	X	X		X		X
019	X	X	X	X		X	X			X	X	X					
020	X	X	X	X				X	X						X	X	
021	X			X		X	X		X						X		X
022																	
023	X			X						X				X		X	
024			X	X									X				
025	X	X			X								X				
026			X	X		X				X	X	X			X	X	
027	X			X		X		X		X	X	X		X		X	
028	X	X	X	X		X	X	X	X	X	X	X		X	X	X	
029		X			X	X		X		X							
030			X	X				X					X		X		X
031		X			X					X							
032	X			X		X					X						
033			X	X				X						X			X
034			X		X	X		X		X							
035	X	X		X		X		X		X	X	X	X	X			X
036	X	X	X	X		X		X			X		X	X		X	
037	X	X	X		X	X	X	X	X		X		X	X		X	
038	X	X	X	X		X		X						X		X	
039	X	X	X	X	X	X		X		X				X		X	
040	X	X	X	X	X	X				X			X	X		X	
041	X	X	X	X		X	X		X	X		X		X	X	X	

I.D. Number	8: Continuous	8: Intermittent	8: Working hrs.	8: Other	9: Yes	9: No	9: No preference	9: NOSS only	9: NOSS & other	9: Both	9: Other	10: Yes	10: No	10: Yes	10: No	10: Other	10: Yes	10: No	10: Other
001	X				X				X			X		X					
002		X			X					X		X		X				X	
003			X		X				X				X			X		X	
004		X			X					X			X				X		X
005					X				X			X		X				X	
006		X			X								X						
007			X		X				X			X		X					X
008		X			X					X	X	X		X				X	X
009		X			X				X			X			X				
010	X				X					X		X		X			X		X
011		X																	
012					X				X				X						
013		X			X				X				X	X			X		
014	X				X					X			X			X			
015		X					X				X	X		X				X	
016		X			X					X		X		X				X	
017	X					X						X		X		X		X	
018				X	X				X				X			X	X		X
019		X			X				X		X	X		X				X	
020		X			X				X			X		X			X		X
021		X			X					X		X		X			X		
022							X						X						
023		X					X					X		X				X	
024		X			X				X				X	X					
025	X				X							X		X		X		X	X
026		X			X				X				X	X				X	
027		X			X					X		X		X				X	
028	X	X			X					X		X		X			X		X
029				X	X			X			X	X				X			
030	X			X	X				X			X		X		X			X
031	X						X				X	X				X			
032		X			X					X	X	X		X				X	
033	X					X				X		X		X		X		X	
034	X				X				X			X		X		X	X		X
035				X	X					X	X	X		X			X		X
036	X	X		X	X				X		X	X		X					X
037	X										X	X		X		X			X
038	X				X					X		X		X				X	
039	X		X		X					X	X	X		X		X	X		X
040	X				X					X	X		X	X					
041		X			X					X		X		X				X	

I.D. Number	11: Yes	11: No	11: Other	11: Yes	11: No	11: Other	13: Publications	13: Workshops	13: Presentations	13: Discipline Grps.	13: Other
001	X			X		X				X	X
002	X			X			X	X			
003	X			X			X				
004	X			X			X	X	X	X	
005	X			X			X	X	X		
006	X			X							
007	X			X			X	X			X
008	X		X				X	X		X	X
009	X			X							X
010	X		X	X		X				X	X
011											
012	X			X		X	X	X			
013	X			X			X	X			X
014	X			X			X	X	X	X	
015	X			X				X			
016	X			X			X	X			X
017	X			X			X	X		X	
018	X						X	X	X		X
019	X						X	X	X		
020	X			X			X	X	X		
021	X			X		X	X	X	X	X	
022	X				X	X	X				
023	X						X				
024										X	
025	X						X	X	X		
026	X			X			X				
027	X			X			X	X	X		
028	X			X			X	X		X	
029	X						X	X		X	
030	X			X						X	
031	X						X	X	X		
032	X			X						X	
033	X		X	X						X	X
034	X						X	X	X	X	X
035	X		X	X			X	X	X	X	X
036	X		X	X		X	X	X	X	X	X
037	X					X					X
038	X		X			X		X	X	X	X
039	X		X	X			X	X			X
040	X		X				X	X	X	X	X
041	X			X					X		

Figure B-1. Tabulation of Commercial Users' Responses

	2										4										5					6							
I.D. Number	Government	R & D	Engineering	Forecast/Pred.	Petroleum	Other (University)	Individual	Agency	Consortium	Other	< 3 hrs.	6 hrs.	12 hrs.	24 hrs.	> 24 hrs. - 1 wk.	Other	1-2 wks.	2-4 wks.	> 4 wks.	Other	Local/Coastal	Regional	Global	Varies	Fixed	Dial/Nearreal	Dial/Nonreal	Comp/Nearreal	Comp/Nonreal	Telecopy	CCTS/Mail	Photo/Mail	Other
001						X	X													X	X	X		X			X				X		
002		X				X	X						X				X				X	X	X	X				X					
003		X				X	X												X		X	X		X								X	X
004		X				X	X				X							X				X		X		X	X		X	X			
005						X	X				X								X		X			X			X			X	X	X	
006		X		X		X	X				X								X			X	X	X				X	X		X		
007						X	X						X	X				X	X		X			X			X			X	X	X	
008		X				X	X				X						X				X	X			X		X		X				
009		X				X	X												X		X			X							X	X	
010		X				X	X						X					X			X	X		X		X		X			X		
011		X				X	X												X				X	X			X		X				
012						X	X				X			X					X		X	X		X		X		X		X		X	
013						X	X													✓	X	X		X					X		X		X
014						X	X																X	X						X			
015						X	X					X										X		X				X	X	X			
016						X	X							X	X				X		X	X	X	X	X	X	X	X	X		X	X	
017		X				X		X					X								X			X		X		X					
018						X	X				X	X	X								X			X		X				X			X
019		X				X	X									✓		X			X	X		X			X	X			X	X	
020						X	X					X	X							X	X				X								X
021						X	X							X					X		X	X						X			X	X	
022						X	X				X						X		X		X	X	X	X				X	X		X	X	
023		X				X	X				X											X		X		X					X		
024						X	X									✓						X		X				X					
025						X	X				X								X		X			X		X		X			X	X	
026						X	X	X			X					X					X	X		X		X	X	X	X	X	X	X	X
027		X				X	X									✓		X			X	X	X		X	X							
028						X	X												X	X	X	X	X	X							X	X	
029		X	X	X		X	X							X							X				X	X		X					
030						X	X				X							X			X	X		X		X			X	X		X	
031						X	X												X			X		X							X	X	
032		X	X			X	X																			X	X	X	X	X	X	X	

	7				8				9							10								11						13				
I.D. Number	Nearreal	Nonreal	Yes	No	Continuous	Intermittent	Working hrs.	Other	Yes	No	No preference	NOSS only	NOSS & other	Both	Other	Yes	No	Yes	No	Other	Yes	No	Other	Yes	No	Other	Yes	No	Other	Publications	Workshops	Presentations	Discipline Grps.	Other
001				X					X				X			X		X						X			X			X	X	X	X	
002		X		X	X				X					X	X		X	X		X		X	X	X		X		X	X	X				X
003		X	X						X				X			X		X			X			X							X		X	
004		X		X					X					X		X		X						X			X				X	X		
005		X		X		X			X				X		X	X		X		X		X	X	X			X			X	X	X		
006	X		X			X			X					X		X								X			X				X			X
007		X				X					X						X			X				X						X			X	
008					X				X					X			X	X				X			X		X			X				
009		X	X						X								X							X			X			X		X		
010	X		X		X				X					X		X		X			X			X			X				X			X
011						X			X				X			X		X			X			X			X				X			
012						X			X				X			X		X						X			X			X	X		X	
013		X	X								X					X		X			X			X			X			X			X	
014						X	X							X		X		X						X									X	
015	X		X			X					X						X							X			X			X	X			
016	X	X	X			X			X					X			X	X					X	X			X			X	X			
017	X		X		X	X			X					X		X		X				X		X			X			X	X	X	X	X
018					X				X					X		X		X						X		X								X
019		X	X			X					X		X		X	X		X					X	X					X	X				
020					X				X					X		X		X					X	X					X	X	X	X	X	
021		X	X			X					X						X	X		X	X		X	X			X			X	X	X	X	
022	X			X		X			X				X		X		X	X		X		X	X	X			X			X		X	X	
023	X		X			X			X				X			X		X				X		X			X				X	X		
024	X		X		X				X				X			X		X			X									X	X			
025	X	X	X		X	X			X					X			X	X						X			X			X	X	X	X	
026	X		X		X				X				X				X	X			X		X	X			X			X	X	X	X	X
027	X		X			X			X				X			X		X			X			X			X						X	
028											X						X	X			X						X			X	X			
029	X			X		X																		X						X	X			
030			X			X	X			X				X	X	X		X				X		X		X	X		X	X	X			
031		X	X						X								X							X			X							
032				X		X			X					X		X		X			X			X			X			X	X	X	X	

Figure B-2. Tabulation of Academic Users' Responses

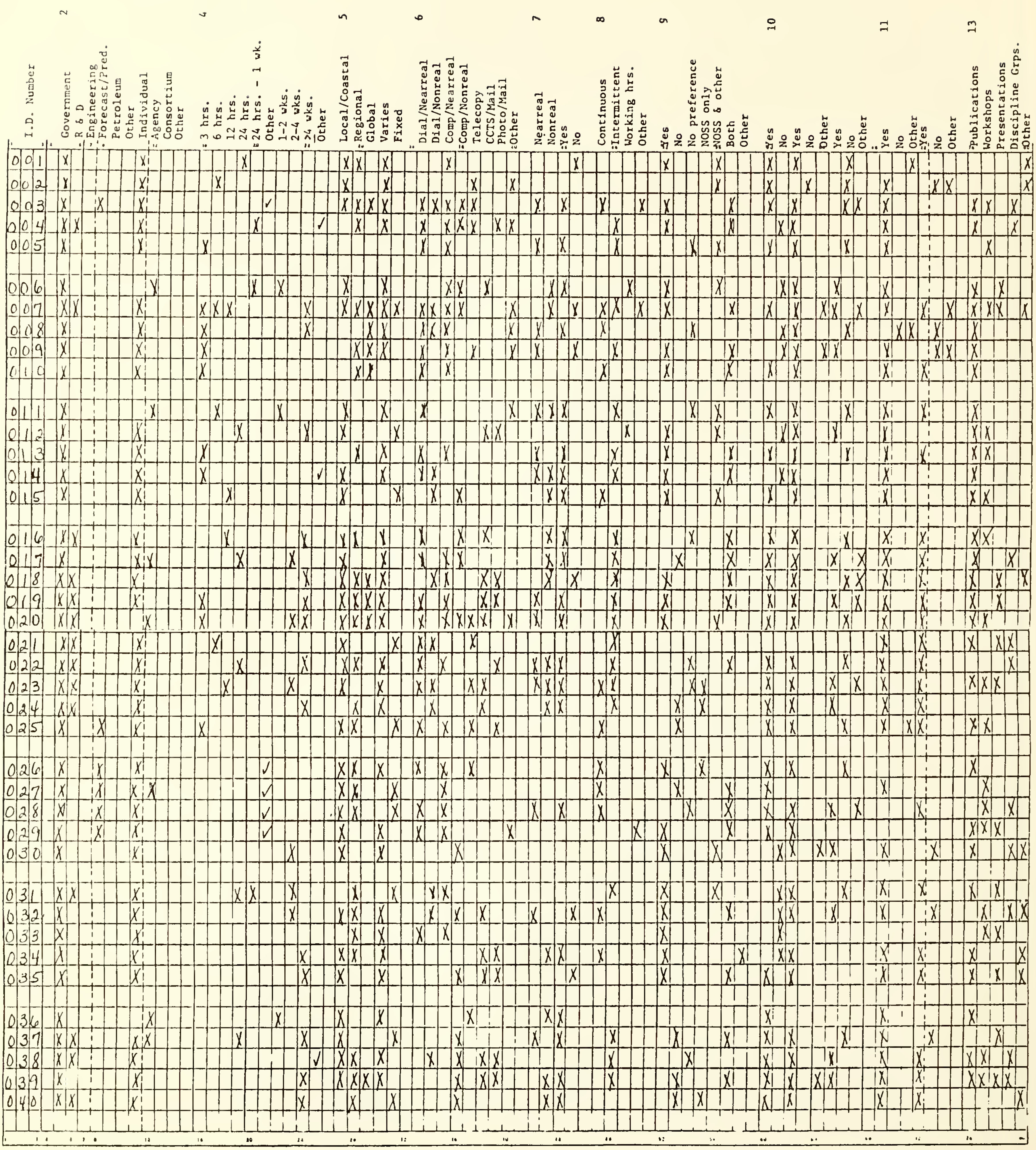

Figure B-3. Tabulation of Government Users' Responses

	2										4										5					6								7				8				9							10								11						13				
I.D. Number	Government	R & D	Engineering	Forecast/Pred.	Petroleum	Other	Individual	Agency	Consortium	Other	≤ 3 hrs.	6 hrs.	12 hrs.	24 hrs.	≥ 24 hrs. - 1 wk.	Other	1-2 wks.	2-4 wks.	> 4 wks.	Other	Local/Coastal	Regional	Global	Varies	Fixed	Dial/Nearreal	Dial/Nonreal	Comp/Nearreal	Comp/Nonreal	Telecopy	CCTS/Mail	Photo/Mail	Other	Nearreal	Nonreal	Yes	No	Continuous	Intermittent	Working hrs.	Other	Yes	No	No preference	NOSS only	NOSS & other	Both	Other	Yes	No	Yes	No	Other	Yes	No	Other	Yes	No	Other	Yes	No	Other	Publications	Workshops	Presentations	Discipline Grps.	Other
041	X						X				X								X		X	X		X		X					X								X			X			X				X		X				X		X			X			X				
042	X						X										X				X	X		X			X				X	X			X	X			X			X				X			X		X						X			X			X	X			
043	X						X											X				X		X			X		X		X	X			X		X					X				X		X	X		X		X	X			X			X			X	X	X	X	
044	X						X												X		X	X	X	X			X		X		X	X							X			X				X			X		X					X	X			X				X		X	
045	X		X					X						X									X		X			X						X		X		X																			X									X	X
046	X						X					X									X			X				X						X		X			X				X						X		X						X			X		X	X				X
047	X						X					X											X	X		X		X	X		X							X				X				X			X		X				X		X			X			X		X		
048	X			X			X					X									X				X					X	X	X			X	X		X				X					X		X		X				X		X			X			X			X	
049	X	X					X	X							X		X	X			X	X			X	X	X	X	X	X	X	X		X	X	X		X		X		X					X		X		X			X			X			X			X	X		X	
050	X	X					X						X						X		X	X		X		X			X	X	X				X	X			X			X					X		X		X			X			X			X			X	X			
051	X						X									✓					X	X		X		X			X	X				X		X		X				X					X	X	X		X				X		X		X								
052	X	X					X											X			X				X			X			X	X			X	X			X			X					X		X		X		X		X	X	X			X			X	X		X	X
053	X						X	X				X					X					X			X	X				X							X		X			X					X		X		X				X		X						X				
054	X						X					X	X								X			X				X							X		X	X				X				X			X		X			X			X						X	X			
055	X			X			X				X										X	X			X					X								X				X					X		X		X				X		X			X			X				
056	X	X					X													✓	X				X		X		X			X			X	X			X							X				X	X						X										
057	X						X												X		X	X		X					X		X	X			X	X			X			X					X		X		X			X		X	X			X			X	X		X	X
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Figure B-3 (Cont'd). Tabulation of Government Users' Responses

APPENDIX C

SUMMARY OF CONFERENCE DISCUSSION TRANSCRIPTS

Following summary presentations by the group moderators, Conference participants had an opportunity to ask questions or make any additional comments concerning the day's activities and/or the NOSS Program. Abridged transcripts of these discussion sessions are presented here for each Conference location. Concluding this Appendix is a composite transcript of the Conference closing comments.

Seattle

Chair: I'd just like to say from our viewpoint that we've received a lot of useful comments from this Conference, and I thank you for all of them. It has been most helpful. One of the things that we do want to discuss here is our continuing interaction, or your views on how to continue interaction with NOAA people working on the NOSS program. So I'll ask at this time if anybody would like to comment on that particular aspect, and if it is something the staff can provide, we'll designate someone to respond.

Comment: Certainly your holding of these meetings is a grand first step. Now if you can only find a way to develop some kind of information bulletin that will come back to those of us who have participated in these meetings in order to keep us informed of developments. You've got a long tough "row to hoe" and you're going to make progress step by step. If we know what you have accomplished, it is going to be a great help to us.

Comment: (Chair) The comment came up with the operational users — the need for some form of newsletter — and I think that's something we'll certainly take into consideration. We'll see what we hear from all of the five conferences but that would certainly be one way of communicating. However, that is only one-way communication. The other thing we want to do is to establish some method of keeping up a dialogue where we can get input on a regular basis. As the system develops and as we develop our NOAA Oceanic Data System for processing and disseminating the data, we'd also like to get your comments as we go along. As you can see from the presentations that we have made today, what we now have is a concept of a NOAA system, and that's where we could use your input and the inputs from the other meetings to better define the functions that will take place, how they will take place, and how we will best serve your needs.

Question: When will these future conferences take place and where will they be held?

Answer: Every year — to discuss the progress and changes that occur as we go along.

Comment: I don't know how expensive it is to sponsor these conferences, but it certainly is very useful as a way to keep up with the situation and also to get users' comments.

Question: What is the expected engineering lifetime of the satellites?

Answer: We expect the instrument life to be three years, so we are essentially developing two complete spacecraft to cover the five-year operational demonstration period.

Comment: I might suggest a possibility. The Oceans '80 Conference goes on every year. This year there will be two of them because the Marine Technology Society (MTS) and Oceans '80 meetings are separate, but they will be going back together in future years. We could fix it up so you could have a one-day symposium at that conference — you could arrange a meeting for the day before or after. That might be one vehicle to get this information out once a year.

Comment: This year the MTS will be having a one-day session on Seasat, Nimbus and the implications with regard to NOSS. I have a feeling you won't hear a whole lot new from what you've heard here today, except for in-depth technical discussions on Seasat and Nimbus-7. The audience will be somewhat different; larger anyway. I have a question with regard to travel.

Question & Comment: I don't know what the travel problems are for private industry if we schedule conferences every year. I expect we would probably drop one and, instead of trying five, probably go to four conferences. We've had a lot of criticism from people located in Washington, DC, saying that we should have held one of them there. We elected (this year, anyway) not to have one there, but the question remains: Is there a problem for many of you in getting to conferences if we do go ahead with this conference approach for keeping you informed and maintaining this dialogue? I know the situation with the government people, but I'd just like to hear this talked about. It may turn out to be the cheapest way to do it.

Comment: Anything is going to cost us money.

Question: You're talking about having them all in Washington, DC?

Answer: No. We'll probably drop one and go to four, of which we might have to have one in Washington now and then. Washington, after all, is the oceanographic capital of the world. (laughter)

Comment: They are the most vocal, anyway.

Comment: Yes, that is one thing to consider. A lot of them control the purse strings, whether we like it or not.

Comment: Well, a combination of the informational bulletins, supplemented by conferences, seems reasonable. Certainly if you get the informational bulletins out and you encourage responses the way you have here with the questionnaire type approach, you're going to cut down on the need for the frequency of the conferences. Mix them up; use both.

Question: Did you get the same number of conference attendees at each meeting?

Answer: No, they vary. We have had about 35 preregistered here; we now have about 60 in La Jolla; around the same number in Woods Hole; 12 in Miami; and 105 in Bay St. Louis. Bay St. Louis is kind of an anomaly, like having a meeting in Washington, DC The Navy people overran us down there, which is fine. It's a good thing that they are interested enough to take time to come and drink beer with us and give us an audience. This (Seattle) meeting falls in the middle attendance wise. I think a handicap here was just the nature of setting up the meeting and coming here first. We might not have allowed some people time to respond. If we do it again, for sure we'll try to set these conferences up with a much longer lead time.

Question: Regarding the proceedings, will you comment on how and when they will be distributed?

Answer: We will put out a report on this meeting and everyone who is registered will get a copy in the mail. We're projecting it will take something on the order of a month to do an analysis of the questionnaires and to come up with some kind of a consistent means of grouping the answers, not only for what's happened here but for the other four conferences. A draft will be available, hopefully, early in July. We will then allow about a month for some sort of official internal approval. It won't be to screen the data; I don't think we are planning to withhold any of the evidence that comes up; that is not the intent. We do have to have a perspective from our management. Hopefully, the final draft will be out about the latter part of August. I would urge you then, if you feel you'd like to come in, to go through the questionnaires yourself and do your own analysis; we'd be glad to work with you. We will use the report as a means of continuing the dialogue and maybe that (the Conference Report) will be our first installation of this newsletter-type approach.

Question: I have one question that may have been answered this morning and I didn't hear it. I get the impression that you are talking about sending things you feel comfortable with up in this satellite, and, since it's not impossible to launch a satellite these days, why is it six years "down the pike" that you are talking about? Is it a budgeting cycle?

Answer: No. By the time we start the design, build the hardware, make all the tests that they put the instrumentation through — the tremendous quality control that does go into it where they do shake tests, RFI tests, and compatibility tests of one sensor at a time to build up the configuration and make sure the radio frequency interference from, say, the scatterometer, is not bleeding back on the radiometer -- it takes a long tme.

Comment: It was mentioned this morning that it takes six to seven years from the conception of a satellite to launch, and we are basing this on experience. TIROS-N also had a new data handling and processing system, but at least we were familiar with the data and we added on to some of the system we

already had. Here we are talking about a more complex system with NOSS, so that's the time it takes just to go through the procurement process. We're going through a conceptual design for nine months, with parallel contractors competing, and this will be completed in February, 1981. By the time you go through the evaluation and selection process it will be August before you have even identified the mission contractor who's going to build the system, install it, and train the people to operate it. We are, hopefully,talking about having these ground systems installed up to a year before launch so that operators can be hired and trained to operate the system. So, when you put all this together you have six or seven years, although (I admit) it sounds like a long time. We think that, in a lot of our discussions within the program, we are behind time right now in some of the things we are trying to do, so this is certainly an average amount of time for implementing a system of this magnitude, based on our experience.

Comment: It is about the same amount of time (needed) to build a Navy weapon system.

Comment: There are a lot of things that must go on. For example, when you are flying strictly radiometer types of instruments that don't radiate, that's one thing. You're pretty much going where you want and expect (them) to go. But none of the frequencies used on Seasat for research purposes have international clearance to be used operationally. So they are having to go through a whole hierarchy of things through the State Department to get allocation clearances to go with these things. It is very time consuming. It takes years.

La Jolla

(Transcript not available)

Woods Hole

Comment: Level-I and -II data can be made available to both the Navy at Monterey and NOAA in as real time as we can get it — within say 60 to 80 minutes after we've received it and it has been properly processed. Now at NOAA, we plan to make the data available to anybody that wants it, as soon as we get it.

Question: You talked about getting Level-I data available on the ship?

Answer: Probably Level-II on the ship but there are people who want Level-I data.

Comment: They want the data to support a mission that they are on.

Comment: We will be able to make Level-I and -II data available within 80 minutes after it is received at the primary center.

Comment: I think what they are doing is expressing their concern ahead of time due to past experiences with data.

Comment: It's a valid concern because right now we have the same thing in the operational units — how are people on ships going to get the data? If we talk about making it available to the guy at sea (which is the issue), how is he going to get it?

Comment: They are worried about this. How long have people waited for CZCS data?

Comment: Getting data to ships at sea is a significant problem that we haven't really addressed.

Comment: I think the other thing that was stressed in the operational area, and I'm not necessarily talking about uniquely NOSS data either, is that you may want data from ships, you may want data from other sources and satellites, and so on. So, we also have to look at this as a NOAA problem, not necessarily a NOSS problem, but one which NOSS can contribute toward solving. The NOAA problem, even now without NOSS, is that we can't get data and, of course, NOSS is going to add tremendously to the data that is going to be available. I think we have to look at it as a NOAA problem.

Question: Were any of the points brought up in the R&D group discussions indicative more of any industry group, research group, etc.?

Answer: They were not addressed as either, specifically. The group was representative of both industry and research, and the concerns were expressed without attaching any specific discipline or type of study to it.

Comment: There is a sincere interest on the part of NOAA to identify the industry as such and their needs. I'm curious to hear from industry reps who are here. There were several points made which I found extremely interesting. I could identify them all with various research groups; but I don't know if they are characteristics as well of the potential industry units.

Comment: That point was also brought out in the discussions about archiving data. The request was made that people say what they would like to have kept, but I don't think anybody knows what they will need five years from now. Whatever you are throwing away is precisely what you are going to need later. You can't plan that specifically, whether you're in research or industry, this early in the game. To get back to one point, if they had more experience with the current semi-available data, they would be able to guess better.

Comment: I don't think there is a difference between industry and research. You seem to be separating them like they are two different worlds. The applications may be different, but the concerns are the same. The concerns for quality and timeliness are the same. It's just the uses of the data that may be different.

Comment: (Chair) Nobody is trying to separate them. The problem has been that nobody could clearly say what the concerns of industry are. Accordingly, it's worth asking, and in that mode, what specifically does industry feel, so that we can clearly know that we have heard from industry representatives.

Question: How do you define industry and how do you define R&D?

Answer: (Chair) That's not an easy one as you well know. But in general, let me give one type of definition. I think the industry interests must lie in those areas where they have a shooting opportunity to produce something unique and which they can sell appropriately — in other words, something in which they have some sort of a proprietary lot. When I talk R&D, it's probably an incorrect version of it as far as you are concerned. I'm only thinking about those things that need to be done and which serve the public good, and accordingly, should not have a proprietary lock on it. That's a bad use of R&D, I agree. But in any event, I look at industry as a group of people who somehow want to produce unique, salable products. Is that wrong?

Comment: I think in the manufacturing industry that's correct; but I think it is hard to characterize all industry that way.

Question: (Chair) How would you do it?

Answer: I don't think you can separate industry and R&D because there are a fair number of industries that do the R&D work — except for a profit.

Comment: In the R&D group, and it was a mixed group, there didn't seem to be any differentiation of opinion at all.

Comment: (Chair) Back to that R&D thing. We have a component of NOAA labelled R&D, and that's my hangup! My script says ferret out ideas about how the oceanographic community would like to stay involved with the NOSS program development. A darn good question! Let me just make a few quick comments about the New England area. We have been concerned, as you have heard, and we have produced a newsletter that may be considered by some as quasi-legal/illegal. I'm not sure that we have a good notion yet of the industry interests here. How do we stay involved, generally? I made the comment about the newsletter being quasi-legal because obviously, if we start sending out a thousand copies of it, we have a major problem with OMB. So, I don't think we can expand that to include everybody on the face of the earth. But we have to look at this question. How do we get everybody appropriately involved? Any ideas?

Comment: I think one good way to get people involved is to make a suggestion in our group. It's one thing to have a NOSS users group and to look six years down the road at what people might need. I would like to identify those people who have a real interest in using the existing data and to share experiences with

the existing users of Seasat and GOES data. I would suggest that if the NOSS staff were to hold another of these meetings, let's say in six months or a year, that the meeting be centered around people, papers, and experiences that people have had with the existing data. I'm just finding it very difficult to focus on lots of data that nobody has really had experience with. My suggestion would be not how we relate to NOSS, but how the NOSS staff would relate to us, and how we could work with them; hopefully, using the data and have another conference of people who could present ideas in actual practical applications.

Comment: (Chair) This point has been raised in connection with romping around looking at the regional needs, and it was raised last Friday by Professor Joe Berry of Yale. He would like to convene some kind of a reasonable symposium with a strong pragmatic vent to it, sometime next fall, looking generally in his interest now at terrestrial problems and specifically at problems associated with vegetation. The question he was asking, in a way, was "Where can I get funding to help out on this?" He needs 10-20K. The second question he was asking was, "Do you think the time has come to go to the discipline route?" Now, in a way that's part of what you're saying. We've got to find some different avenue of approach, a different perspective. I'm a little bit surprised, frankly, that this need is here, although I've learned to accept it. Since we started putting the newsletter out (today I heard that the mailing list has grown to 200 people just in the New England area), the amount and the diversity of interest is incredible.[13] So, maybe following your suggestion, within NOAA we should do our best, too. I think all of us ought to get together at a somewhat higher level and address in different regions of the country the kind of things we can sponsor. In truth, we are interested in NOSS, we're interested in Landsat, we're interested in more orbitors, we're interested in all kinds of things, and one needs to look at the full spread of data that is available and what the potentiality is.

Key Biscayne

Comment: (Chair) I hope that, in filling out the worksheets, the R&D group will focus on specific R&D questions rather than solely operational approaches. We have concentrated on data collection and we need to extend efforts into using the data in the user and operational community.

Question: At the end of three years, how do we decide if the program has been successful or not, and who is "we"?

Answer: We don't have a plan as to "how" yet, though it will be a combination of civilian and military users. The three agencies involved will work up an evaluation criteria ahead of time. We are aware that we have this ahead of us, and people are working in this area now. (Note:

The "we" as used here referred explicitly to the tri-agency NOSS program.)

Comment: Regarding the specific steps being taken with algorithm development, there needs to be a free flow of information. Also, there needs to be current data and better documentation. Documentation seems to be the key.

Comment: The National Weather Service has 13 people who extract information and who may possibly provide valuable feedback to NOSS, though with a bias.

Comment: We have Levels-I thru -IV of data. It may prove equally useful to categorize users.

Comment: Out of this Conference there are as many questions generated as answers. It may be useful to have another conference or series of conferences where the questions are presented ahead of time. Perhaps a list of questions arising out of this meeting may be compiled and then answered at a subsequent conference.

Comment: I see things more clearly now at 4 o'clock than I did at 9 o'clock this morning.

Comment: We are aiming for September to discuss what the NOAA Unique System (now designated as the NOAA Oceanic Data System) will do. Before we can go out to industry, however, we need to put together an RFP.

Comment: It may be important to people outside the government to have some input on what this source evaluation material would be.

Question: In the R&D meeting, was there any discussion centering around synthetic aperature radar systems?

Answer: It was not brought up in detail.

Comment: Not much is happening in this area. Much of the phenomena which has resulted from SAR was not anticipated and, therefore, no ground support was made available. SAR is basically not being considered because we don't have sufficient justification on cost based on the limited, known applications.

Question: What is the current cost of NOSS?

Answer: $800 million for the 5-year period.

<u>Bay St. Louis</u>

Comment: The 25% research capability on NOSS should be considered for improved communications for medical reasons (scuba divers, etc.).

Question: Do we know the time delay between direct readout level (DOMSAT) versus Level-II data from Navy or NOAA processing facilities?

Answer: Level-II data will be available by NOAA-unique (now designated as the NOAA Oceanic Data System) as soon as it comes to us. Within milliseconds of when data gets there, it will be available.

Question: Will we have any impact on the NOSS system?

Answer: The system is capable of generating many products, but it is important to identify requirements so they can be put into the system. Impact is in the data area and what NOAA will do with that data system. Up to now, the system has been driven by NOAA and Navy requirements.

Question: Two universities, Scripps and University of Miami, have their own receiving stations. What is the NOAA position on encouraging or discouraging these two groups?

Answer: If you are referring to direct readout, there are no plans for direct readout from NOSS spacecraft to the civilian community. These data are encrypted. (Note: However, the civilian community, if appropriate licensing is obtained,should be able to read out the Level-I and Level-II data from the NOSS Primary Processing Facility via DOMSAT at the same time that it is read out at the DOC/NOAA User Processing Center located at Suitland, Maryland. See Figure III-3.)

Question: Is there any possibility of getting a NOSS system operating before mid to late 1980's?

Answer: No. Not before 1986. It currently takes 6 to 7 years to develop and launch a satellite system.

Question: Are there plans to restudy or revalidate the NOSS orbit, or is it fixed?

Answer: The orbit is sun-synchronous. Only the altitude is not fixed.

Composite Closing Comments

Hopefully, everybody is satisfied with the meeting. We are not anxious to conclude this discussion, but if you have specific comments about how we might improve the nature, not only of this Conference, but also those in the other locations, we would like to hear them. It was not clear to us that we necessarily should have broken the topical groups into the "Operational Users" and the "R&D Users," but it was a convenience to us in order to stimulate a dialogue through smaller group sessions. We welcome that kind of feedback.

We will take the completed Worksheets, analyze them and compile them into a report. The time frame for the report is such that we will have a closing on the initial Worksheet responses on June 16. We will spend about two weeks doing a fairly quick overview analysis of those responses and try to establish the major concerns and similarities between all topics. The draft report will have to be reviewed by NOAA Management, and then we will publish and distribute copies of that report to you, hopefully by Labor Day. We would like feedback on the conference report. If you feel that we have manipulated the responses in any way, we would also like to know that. However, we have tried to provide a fair appraisal of where NOAA stands, what the appraisal is of the NOSS system and the data sources for you.

It was suggested that maybe we should have another conference in six months or so, if I heard correctly. But suppose NOAA does take it as an action and agrees to hold regional conferences of some sort, how often should they be? We could not meaningfully have them every quarter. I don't know whether we could even support them on a six month basis. It might be the sort of thing we could schedule in with other types of meetings, such as the annual Marine Technology Society meetings. Perhaps we could put in a day or so on the NOSS status either before that meeting or afterwards. That would minimize travel costs for a lot of the

people, both the research group and the commercial interests. We might approach different communities in terms of professional organizations. The Offshore Technology Conference in Houston, for example, might be a good way to deal with the petroleum and offshore platform users.

NOAA wants to be a service agency for you, and I do thank each of you for taking the time out of your schedules to come and share your requirements with us. Your comments and requirements will mold the thinking of what goes into the NOSS data distribution activity by NOAA, which involves a continuing dialogue.

That is what we do want — a dialogue and not a one-way street. I think the satellite philosophy has changed. If you look at meteorological systems, they have been basically responsible to one customer—the National Weather Service. The oceanic community is certainly far more diverse and made up of many more different groups, both in the government as well as in the private sector, who require marine information. We will do our best to work with you and satisfy the maximum number of requirements.

In closing, I would like to especially thank the Conference chairman for his time and support and the moderators for facilitating the discussion groups. I would also like to express our gratitude to Human Resources Management for their efforts in coordinating the logistics of the Conference. Now, if there are no further comments, I will declare the meeting adjourned.

[13] This informational newsletter is not a formal publication. It is designated as the "Northeast Area Remote Sensing Notes" (NEARS) and is available by contacting Mrs. Helen Mustafa, c/o Northeast Fisheries Center; NMFS/NOAA; Woods Hole, MA 02543.

APPENDIX D

TEMPORAL RESOLUTION CONSTRAINTS OF POLAR ORBITING SATELLITES

Polar orbiting earth satellites have an inherent capability to make global environmental observations. The time required to achieve global coverage depends primarily on the orbital altitude and inclination and the swathwidth of the sensors onboard the satellite.

This discussion is directed toward the anticipated general characteristics of the satellite component of the National Oceanic Satellite System (NOSS). The final altitude has not been selected, but it most probably will be between 600 to 900 km. Further, the NOSS orbit will be sun-synchronous which fixes the orbital inclination as shown in Figure D-1. For purposes of illustration, the surface coverage omitted at the earth poles is not considered, but for the NOSS sensors operating between 600 to 900-km altitude, this is only about 0.1 % or less, for each instrument except the altimeter. The altimeter misses as much as 1.2 % of the global area located at the poles.

Because the inclination and altitude are directly coupled for sun-synchronous orbits, their effect is considered together as illustrated in Figure D-1. It is possible to regard all satellite orbits in terms of a ground trace repetition parameter, Q, where $Q = 360^{0} / S$; S being the longitudinal separation in degrees of descending (or ascending) equatorial crossings between two successive satellite revolutions. S represents the surface trace shift between orbits and is around 24^{0} to 26^{0} for 600 to 900-km orbits under consideration. Thus, Q is typically around 2500 km separation for successive revolutions.

In general, Q can be expressed as an integer and a rational fraction reduced to lowest terms. Choosing Q to be an integer results in a trace pattern which repeats itself every day. Thus, for Q = 14 the orbit repeats itself every day and the satellite nadir point trace at the surface is the same every day. The altitude and inclination for this orbit are 894 km and 99.97^{0}, respectively, as indicated by the upper scale in Figure D-1. If Q is not an integer, then the denominator of the fraction defines the number of days it takes the ground trace to repeat itself (cyclic frequency). Thus, there are a large number of possible orbit repeat times between 600 to 900 km. For example, using Figure D-1 an orbit at about 809-km altitude (14.25 = 14-1/4 orbits/day) repeats every 4 days, while an orbit at about 726 km (14.5 = 14-1/2 orbits/day) repeats every 2 days, so that there are certain altitudes that provide "tuned" orbits that repeat often.

The cyclic frequency of the exact orbit repetition, when coupled with the sensor swathwidths at the surface, determines the temporal coverage of the satellite system. The NOSS LAMMR, CZCS and scatterometer have essentially the same swathwidths of 1370, 1200, 1320 km, respectively. These swathwidths essentially fill half the distance between successive orbits (i.e., 2500 km between the orbits for the altitudes being considered). Thus, the 14 or so orbits which occur in a 24-hour period will acquire data from about one-half the global area, and hence, about two days are required to view the entire globe. An exact two-day repeat (Q = 14-1/2) would leave some areas always unobserved by the 1200-km swathwidth of CZCS. The actual build-up of surface coverage is illustrated in Figures D-2, D-3 and D-4 for CZCS, LAMMR and the scatterometer, respectively. For LAMMR and CZCS 90 % global coverage, orbits between 700 to 800 km are somewhat better than all others, requiring about 25 to 26 orbits. However, the coverage is somewhat sensitive to the total global fraction required, because if a 95%-coverage criteria is used, then the fastest coverage is achieved by orbits between 700 to 750-km altitude.

The LAMMR and scatterometer instruments, since neither depend on solar illumination as does the CZCS, can use both

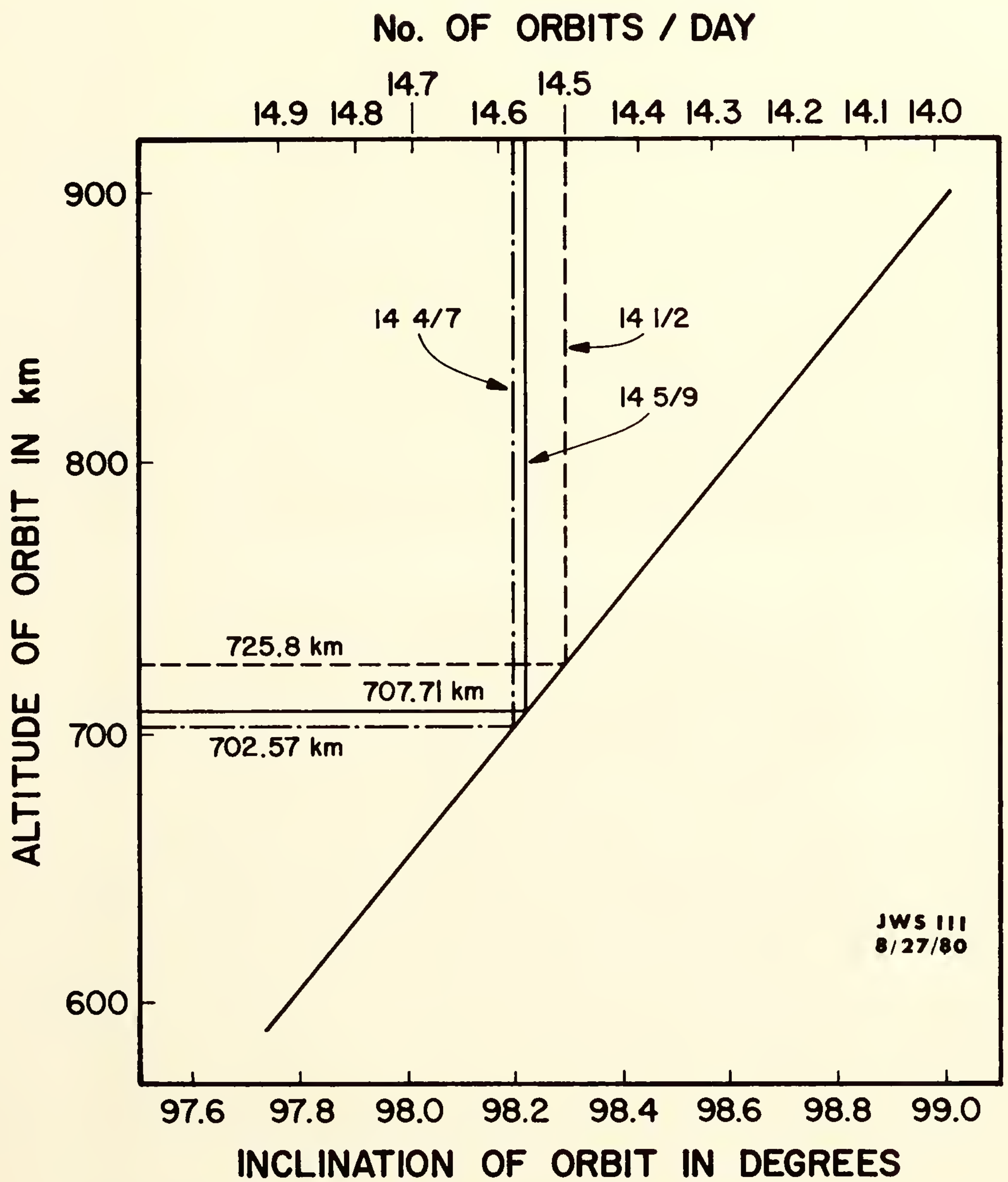


Figure D-1. Interdependence of altitude and inclination for sun-synchronous polar orbits.

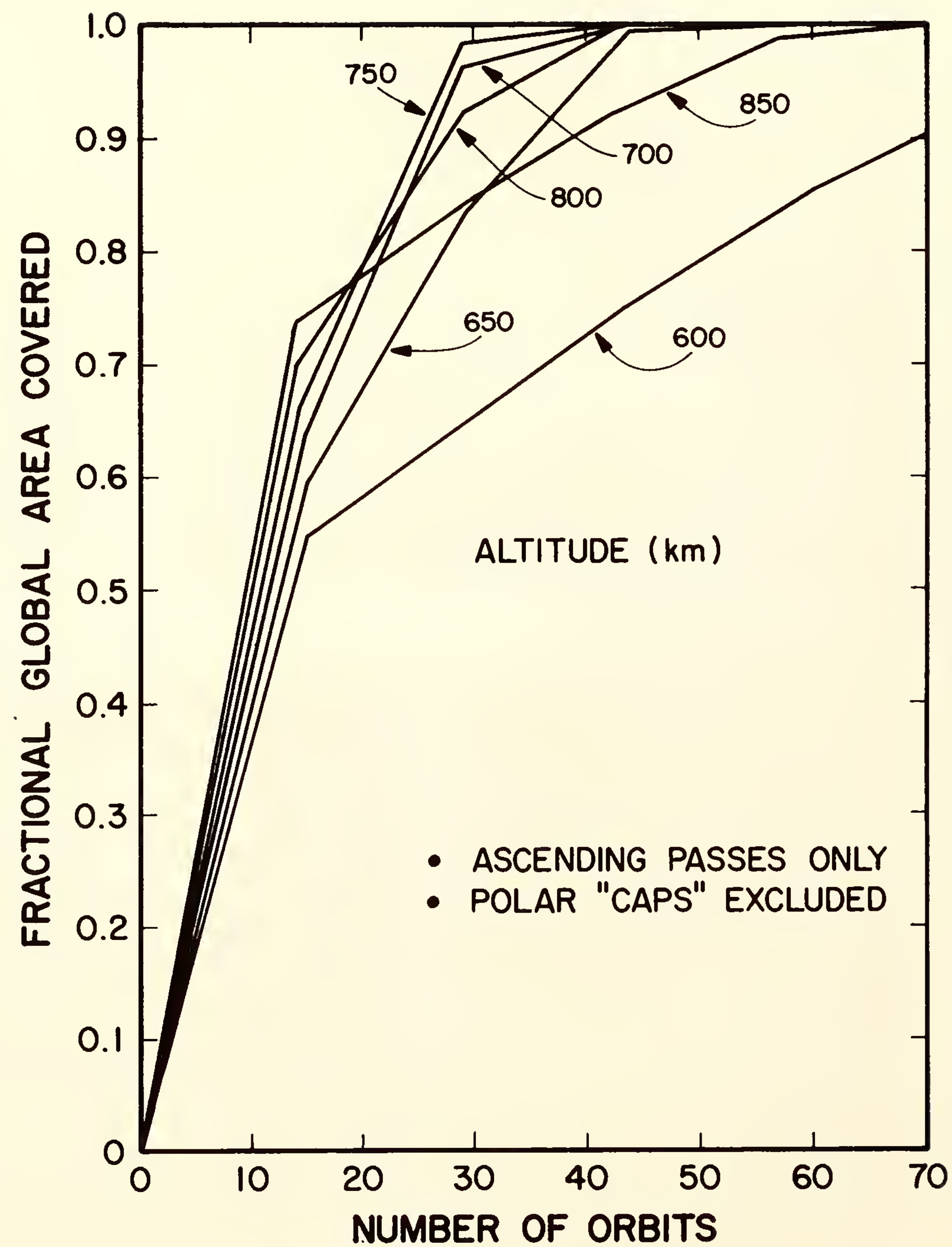


Figure D-2. CZCS global area coverage

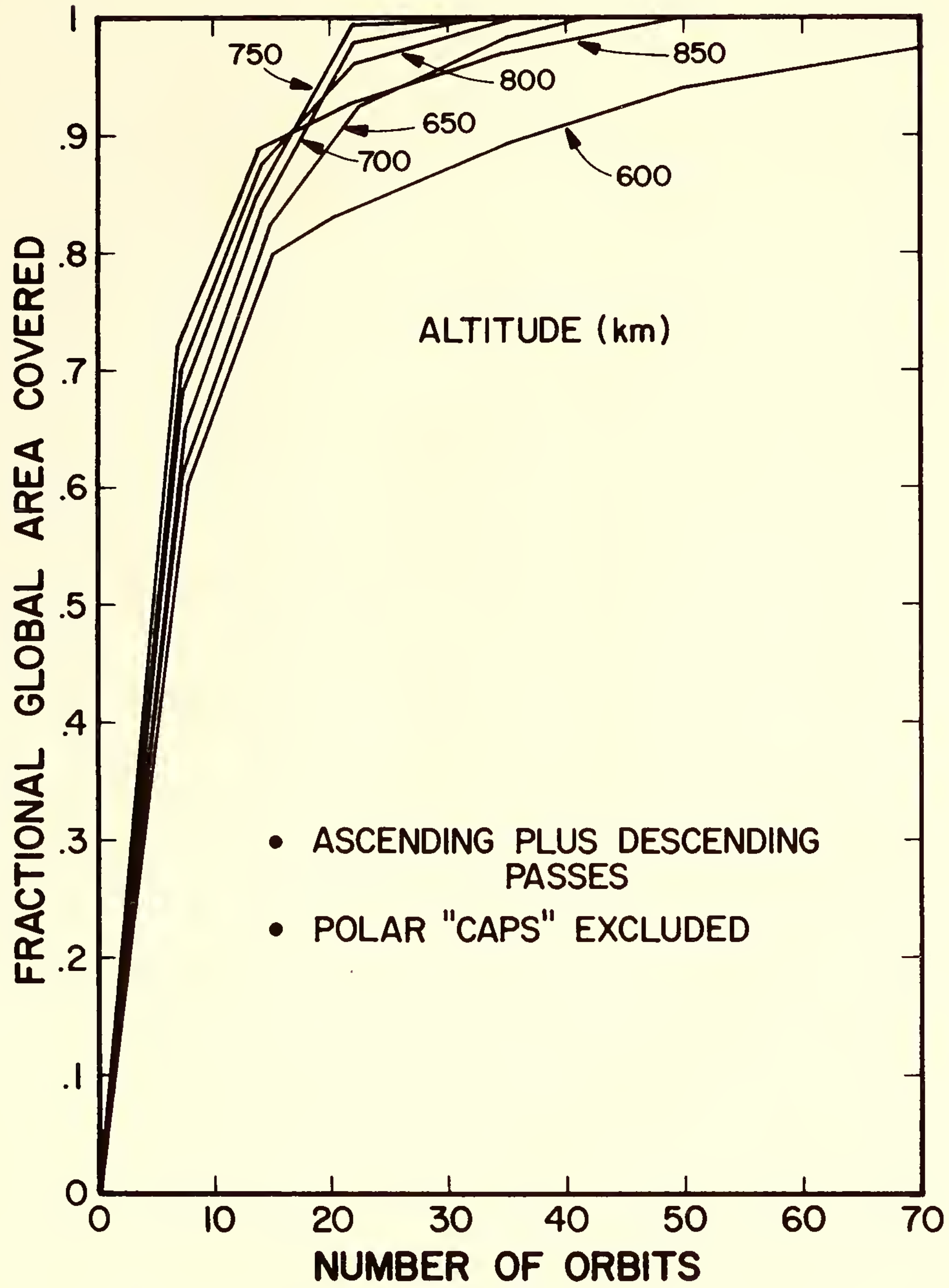


Figure D-3. LAMMR global area coverage

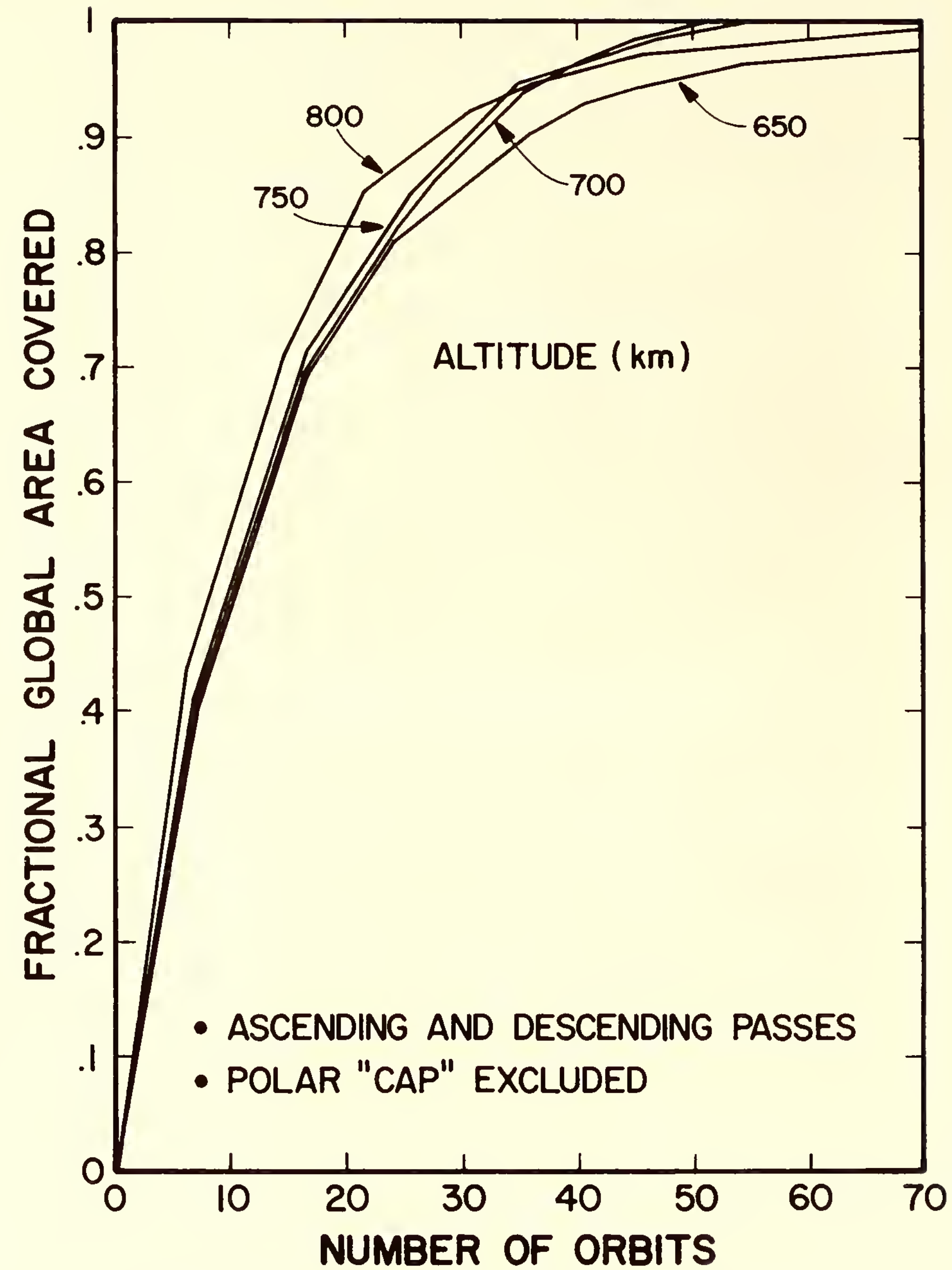


Figure D-4. Scatterometer global area coverage

ascending and descending orbital passes. For orbits in the 700 to 750-km altitude region, 90 % coverage is achieved in 17 and 26-30 orbits for the LAMMR and scatterometer, respectively. For 95 % coverage, 20 and 36 to 40 orbits are needed for these two sensors, respectively.

The scatterometer swathwidth is not contiguous across its 1320 km extent. The 320-km "hole" below the spacecraft (see Appendix F) requires additional orbits in order to obtain global coverage. This makes the orbit sensitive to the altitude primarily because if the orbit repeats before the "hole" area is filled, that area is never viewed by the scatterometer. At an altitude of about 726 km (see Figure D-1) the orbit repeats every two days, and while the outer edge of the swathwidth of the scatterometer has achieved its coverage (essentially the same as LAMMR), the "hole" has not been filled. Thus, the general characteristics shown in Figure D-4 are very orbit specific. This is illustrated in Figure D-5 using the 715-km orbital altitude which shows that as the orbit approaches 726 km (Q = 14-1/2) the "hole" is filled increasingly slower, with 60 orbits required for even 95 % coverage, whereas 52 orbits yield 100 % global coverage at an altitude of 700 km. Typically then, tuned orbits with repeats of up to three days do not provide good coverage with the scatterometer.

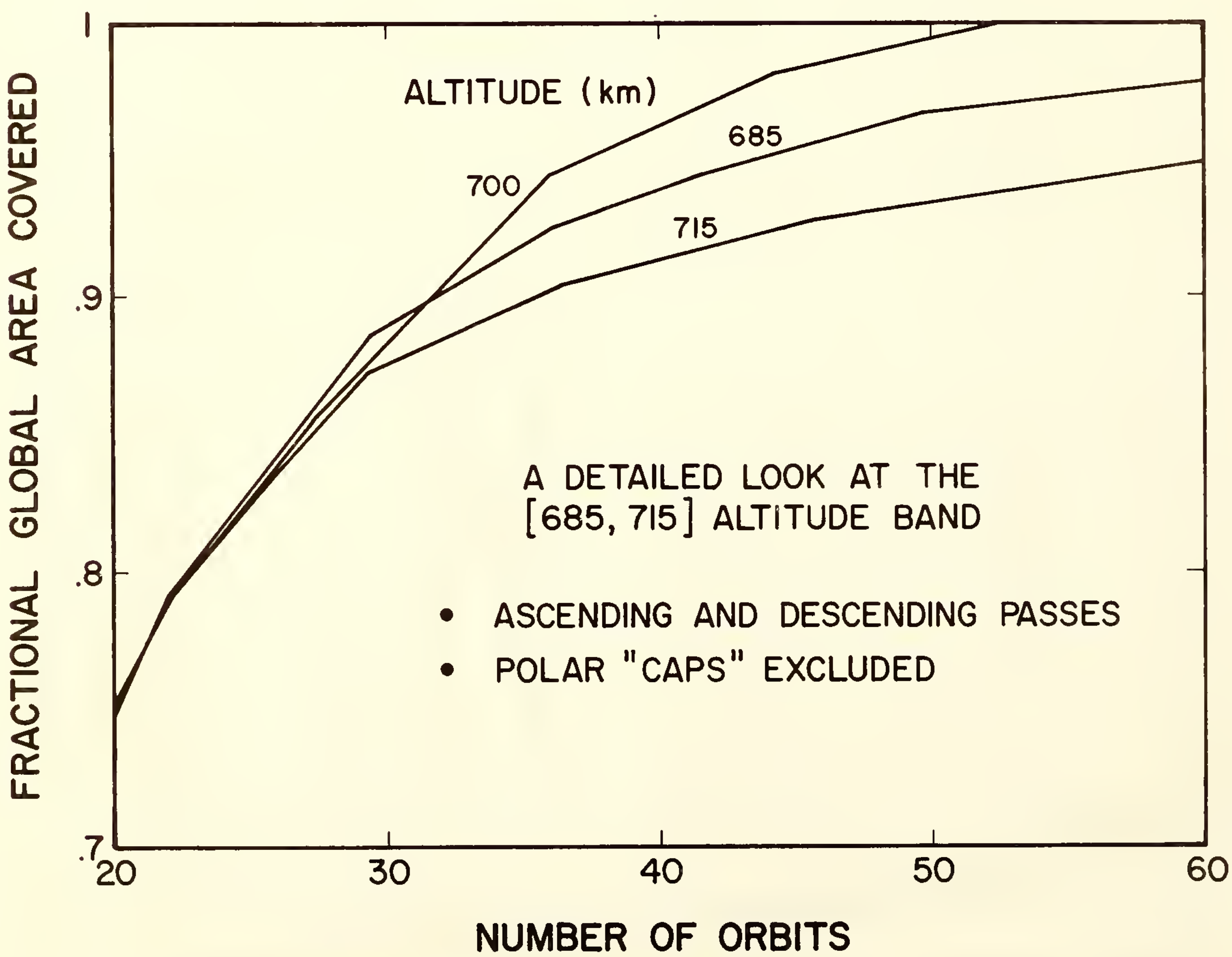


Figure D-5. Scatterometer global area coverage at ±15km

An orbital altitude of about 700 km $\pm$ 10 km appears to be the best overall compromise for three of the four NOSS sensors. Specific orbits at about 703 and 708 km have been noted on Figure D–1 which will have repeats of 7 and 9 days, respectively. For the altimeter, these two potential orbits will have nadir–point trace separations at the equator of 1.77^{o} and 2.75^{o} if both ascending and descending orbits are used, respectively. This results in an altimeter grid system of 177 km and 275 km for the 7– and 9–day repeat orbits, respectively.

To further illustrate the extreme sensitivity of designing the 700–km altitude orbit to satisfy various altimeter applications, consider that the original Seasat baseline orbit was designed to provide an 18–km grid at the equator. This Seasat orbit repeated every 152 days. For the NOSS altimeter, an 18–km grid at the equator requires about 2000 orbits. An orbit with a Q of $14\frac{80}{139}$ satisfies this requirement, with 2026 orbits separated by 17.78 km at the equator. The precise altitude of this orbit is 701.24 km.

In concluding this overview analysis of orbital characteristics, it is important to note that a tuned orbit of 1 or 2 days could be very useful during the initial period of validation after the launch of the NOSS spacecraft. An orbit at about 726 km, illustrated in Figure D–1, is near enough to the 700 km altitude so that a large amount of energy does not have to be expended to change orbits, and as noted above, it provides a 2–day repeat cycle. This feature would allow for ships and buoys to collect surface information every 2 days for NOSS calibration, rather than waiting 7 to 9 days. Hence, it has been proposed that the NOSS orbital altitude initially be placed at about 726 km for validation and subsequently changed to 700 $\pm$ 10 km.

APPENDIX E

SENSOR DESCRIPTIONS FOR SEASAT AND NIMBUS-7

Introduction

The five principal oceanic sensors carried on Seasat and Nimbus-7 have been briefly discussed in Chapter II, Section 4. Details are provided here on the coverage and characteristics of the Seasat radar Altimeter (ALT), scatterometer (SASS), Scanning Multi-channel Microwave Radiometer (SMMR), and synthetic aperture radar (SAR), and the Nimbus-7 SMMR (identical to Seasat) and Coastal Zone Color Scanner (CZCS).

The foot print comparison of all Seasat sensors is given in Figure E-1.

Radar Altimeter (ALT)

The altimeter was a nadir-viewing, short-pulse, 3 ns radar operating at 13.5 GHz. This instrument measured the vertical distance from the spacecraft to the ocean surface along the sub-satellite trace with an accuracy of $\pm$ 10 cm rms. Global coverage required 152 days. The data obtained provides the sea surface geoid and allows mapping of prominent surface depressions, such as deep ocean trenches. Elevations resulting from seamounts, plateaus and ridges, and heights associated with geostrophic currents are also detected. Figure E-2 cites the instrument specifics.

Seasat Scatterometer System (SASS)

The scatterometer was a dual-polarized system operating at 14.59 GHz. The antenna radiated four fan beams (two orthogonal pairs) which point $\pm$ 45 deg and $\pm$ 135 deg relative to the direction of flight. These beams illuminated the ocean surface for a distance of 1000 km on either side of the sub-satellite track. Spatial resolution elements, 50 x 50 km, were produced by range gating and the use of fifteen doppler filters along each fan beam as shown in Figure E-3. The resolution cells from the fore and aft beams produced nearly overlapping orthogonal pairs with incident angles almost equal.

Scanning Multi-channel Microwave Radiometer (SMMR)

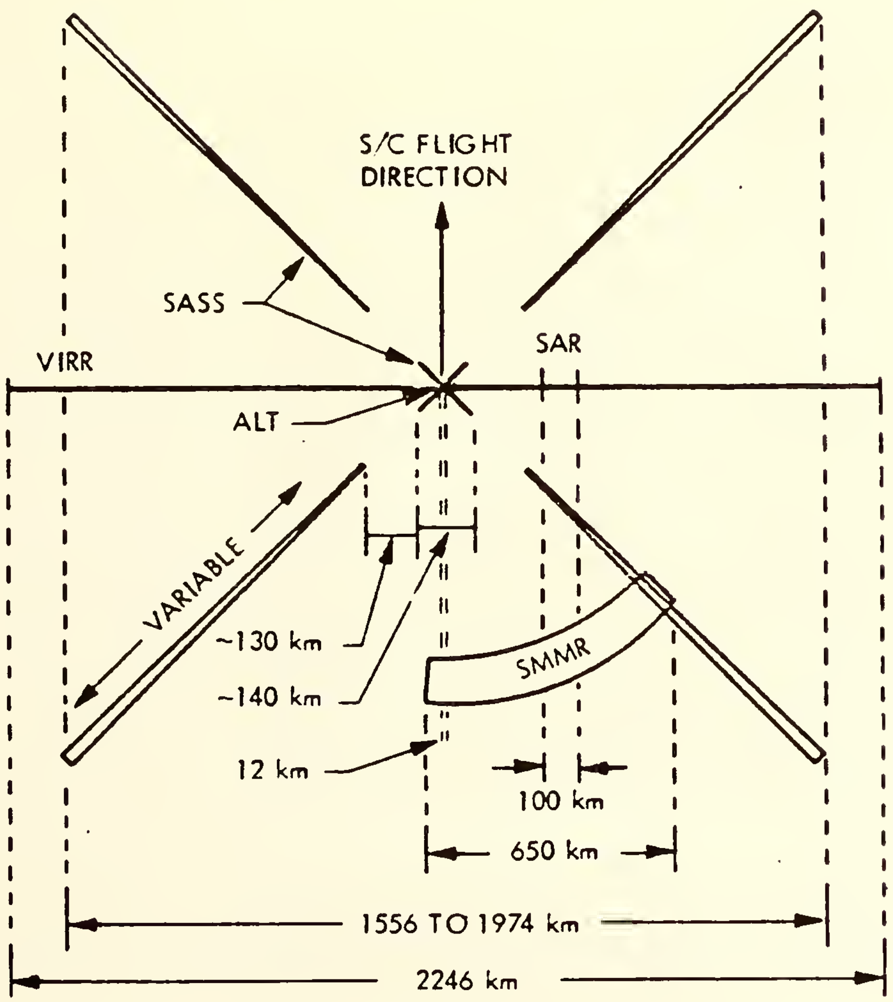
The Scanning Multi-channel Microwave Radiometer (SMMR) was a dual-polarized radiometer that measured microwave radiation at five frequencies: 6.63, 10.69, 18, 21, and 37 GHz. This instrument generated a conical scan to the right of the sub-satellite track at an incident angle of about 50 deg. It recorded data in a swath 659 km-wide for a series of elliptically shaped cells of varying sizes, depending on frequency as shown earlier in Figure E-1. The major axis of these elliptical cells varied from 121 km at 6.63 GHz, to 21 km at 37 GHz.

The use of five frequencies permitted the radiometer to serve as an intermediate-to-high speed windfield anemometer (no wind direction), to measure sea surface temperature, to estimate corrections for atmospheric water vapor and liquid water, and to monitor sea ice conditions. Additional characteristics are given in Figure E-4.

Synthetic Aperture Radar (SAR)

The Synthetic Aperture Radar (SAR) was an L-band 1.27 GHz radar with excellent cloud and rain penetration capability. The antenna illuminated a swath 100 km-wide to the right of the flight track. The design provided spatial resolution of 25 m in both range and azimuth. Figure E-5 shows the principles of surface element resolution. Range resolution was determined by the effective radar pulse length; azimuthal or cross-range resolution was determined by the antenna beamwidth.

The image was formed from two bands of information. Range information was derived from the roundtrip travel time of radar echoes



INSTRUMENT POINTING (DEGREES)

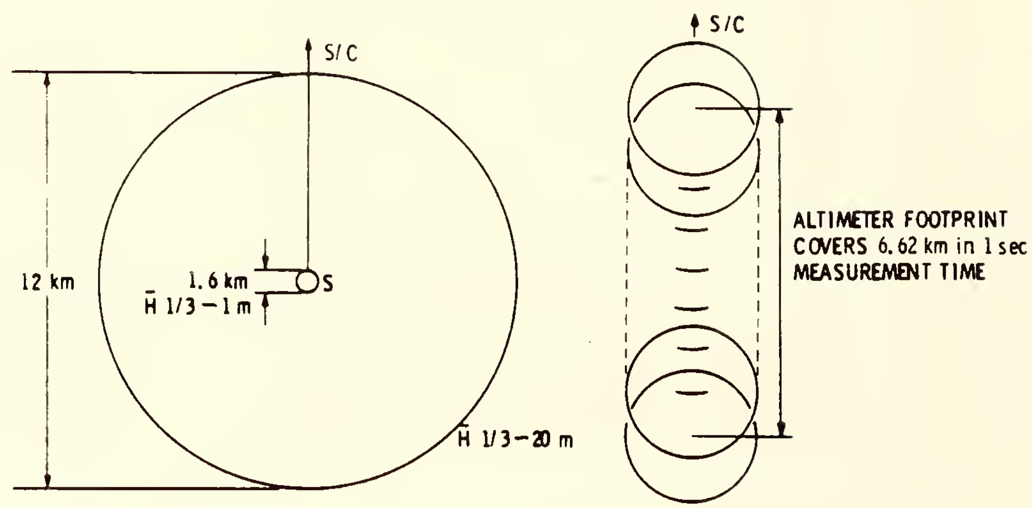
	CONE	CLOCK	FOV
ALT	0	0	1.5 CIRCULAR
SAR	20.5	90	±3 CONE
SASS	0-7, 19.5-55	45	±0.25 CROSS CONE
	"	135	"
	"	225	"
	"	315	"
SMMR	42	133-183	±2 CONE
VIRR	51.38	90,270	±0.15 CROSS CONE

Figure E-1. Seasat-A instrument coverage

PERFORMANCE

- SIXTY-EIGHT PERCENT (1σ) OF ONE SECOND ALTITUDE MEASUREMENTS TO LIE WITHIN ±10 cm OF THE FITTED MEAN
- REAL TIME ONE SECOND SIGNIFICANT WAVEHEIGHT (H 1/3) MEASUREMENT ACCURACY AT LEAST ±10% OR 0.5 m WHICHEVER IS GREATER FOR H 1/3 FROM 1 TO 20 m
- BACKSCATTER MEASUREMENT ACCURACY WITHIN ±1.0 dB

COVERAGE



TECHNICAL CHARACTERISTICS

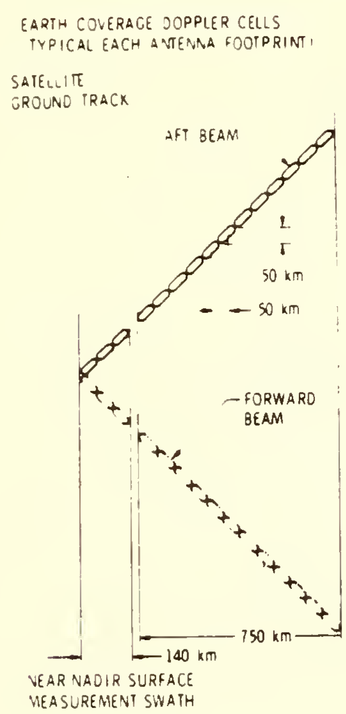
- FREQUENCY - 13.49932 GHz ±160 MHz
- BANDWIDTH - 320 MHz
- TRANSMIT TIME/TOTAL TIME - 3.3 x 10^{-3}
- PULSE WIDTH - 3.2 μsec
- CHIRPRATE - 100 MHz/μsec
- PULSE COMPRESSION - 1000
- TIME BANDWIDTH PRODUCT - 1000
- EFFECTIVE PULSE WIDTH - 3.2 nsec
- PEAK TRANSMITTED POWER - 2.0 kW
- PRF - 1030 PULSE/sec
- AVERAGE TRANSMITTED POWER - 8.25 W
- AVERAGE POWER INPUT - 150 W
- ACQUISITION SIGNAL - 3.2 μsec PULSE MODULATED BY CW SIGNAL
- SYSTEM NOISE TEMP FIGURE - 11 dB
- RECEIVER GAIN - 95 dB
- GAIN - AUTOMATIC, DIGITAL
- AVERAGE BACKSCATTER - 6 dB
- RECEIVER DYNAMIC RANGE - 63 dB
- RECEIVER POWER RANGE -
- ANTENNA PEAK GAIN - 40 dB
- ANTENNA POLARIZATION - LINEAR
- SCI DATA RATE - $\}$ 8.5 kbps TOTAL
- ENG DATA RATE -
- WEIGHT - 72 kg

Figure E-2. Altimeter technical summary

PERFORMANCE

- MEASUREMENT INTEGRATION - 1.89 sec
- MAXIMUM BIAS ERROR ≤ ± 2 dB
- SYSTEM CALIBRATION ± 0.2 dB
- OCEAN SURFACE WIND SPEED - 4 TO > 28 m/sec ±2 m/sec OR 10% WHICHEVER IS GREATER
- OCEAN SURFACE WIND DIRECTION - 0-360 ± 20
- SWATH - AS SHOWN IN COVERAGE FIGURE
- CELL RESOLUTION - 50 km
- CELL GRID SPACING - 50 km x 50 km

DOPPLER CELLS



TECHNICAL CHARACTERISTICS

- BACKSCATTER/ RECEIVED SIGNAL:

BACKSCATTER, dB

WIND, m/sec	ANGLE, deg 25	55
4	-16	-28
25	-4	-13
48	0	-7

RECEIVED SIGNAL, dBm

WIND, m/sec	ANGLE, deg 25	55
4	-138	-143
25	-126	-128
48	-122	-122

EXTRAPOLATED FROM LOWER WIND SPEED DATA

- FREQUENCY - 14.59927 GHz
- BANDWIDTH - ±500 kHz
- TRANSMIT TIME/TOTAL TIME - 0.2
- PULSE WIDTH - 4.8 msec
- PEAK TRANSMITTED POWER - 110 W
- PRF - 34 PULSES/sec
- AVERAGE TRANSMITTED POWER - 20 W
- AVERAGE RAW POWER - 80 W REGULATED
  - 85 W UNREGULATED
- RECEIVER NOISE TEMP 1250°K
- GAIN CONTROL - AUTOMATIC
- ANTENNA PEAK GAIN - 32.5 dB
- ANTENNA POLARIZATION - HORIZONTAL/VERTICAL
- DATA RATE - 540 bps

Figure E-3. SASS technical summary

PERFORMANCE

- OCEAN SURFACE WIND SPEED FROM 7 m TO 50 m/sec ±2 m/sec OR ±10%, WHICHEVER IS GREATER
- OCEAN SURFACE TEMPERATURE TO WITHIN ±2°C ABSOLUTE AND ±0.5°C RELATIVE
- WIND AND TEMPERATURE RESOLUTION - 121 km
- ICE FIELD MAPS. RESOLUTION - 21 km
- MEASUREMENT OF INTEGRATED ATMOSPHERIC WATER VAPOR AND LIQUID MATTER IN A COLUMN ALONG THE SIGNAL VECTOR
- MEASUREMENT OF RAIN DROP SIZE AND DISTRIBUTION IN A COLUMN ALONG THE SIGNAL VECTOR

TECHNICAL CHARACTERISTICS

- CLOCK INPUTS - 1 Hz, 10 kHz, 1.6 MHz, SATELLITE TIME
- ENG AND SCI DATA RATE - 2 kbps
- WEIGHT - 53 kg
- PRIME POWER - 61 W (AVERAGE)

FREQUENCY, GHz	6.63	10.69	18	21	37
ANTENNA DIAMETER, m	0.79				
ANTENNA BEAMWIDTH, HALF-POWER, deg	4.2	2.6	1.6	1.4	0.8
POLARIZATION	DUAL LINEAR				
FOOTPRINT DIMENSIONS, km: MAJOR AXIS	121	74	44	38	21
FOOTPRINT DIMENSIONS, km: MINOR AXIS	79	49	29	25	14
FULL SWATH ANGLE, deg	50				
SWATH ARC WIDTH, km	659				
INCIDENCE ANGLE OF BEAM CENTER AT SURFACE, deg	48.8				

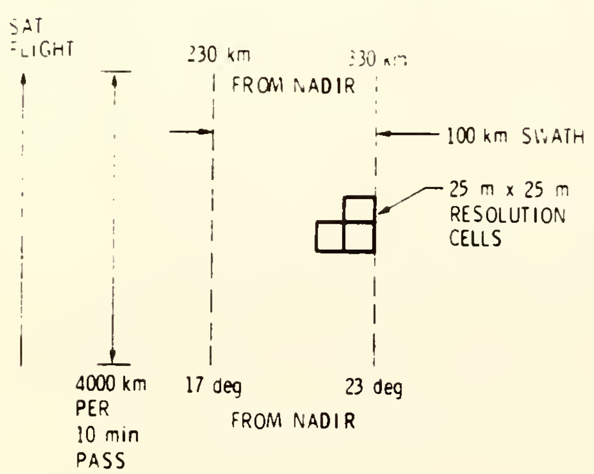
ORBITAL ALTITUDE, km	794				
RF BANDWIDTH, MHz	250				
DISSIPATIVE LOSSES: ORTHOMODE TRANSDUCER, dB	0.55	0.37	0.52	1.03	0.3
WAVEGUIDES, dB	0.25	0.34	0.25	0.2	0.2
SWITCHES AND ISOLATOR, dB	0.6	0.6	0.6	0.7	0.7
TOTAL DISSIPATIVE LOSSES, dB	1.4	1.21	1.37	1.93	1.2
NOISE FIGURE (MIXER + IF AMP), DSB, dB	4	4	5	5	5
SYSTEM NOISE TEMPERATURE (REFERRED TO PORT OF MODULATOR), DSB, K	490	490	692	703	728
PREDETECTION BANDWIDTH, MHz	100				
INTEGRATION TIME CONSTANT, milliseconds	126	62	62	62	30
TEMPERATURE RESOLUTION, K (1σ) (300K TARGET)	0.51	0.72	0.89	1.01	1.23
ABSOLUTE TEMPERATURE ACCURACY, K (1σ)	2				
DYNAMIC TEMPERATURE RANGE, K	10-330				

Figure E-4. **SMMR technical summary**

PERFORMANCE

- RADAR IMAGES AND INTENSITY SPECTRA OF WAVES IN DEEP OCEAN AND NEAR COASTS
- RADAR IMAGES OF SEA ICE AND FRESHWATER ICE
- RADAR IMAGES OF LAND AND SNOWCOVER
- 100 km SWATH WIDTH, 4000 km SWATH LENGTH IN 10 min PASS
- FOUR INDEPENDENT CELL MEASUREMENTS (4 LOOKS)
- 25 x 25 m CELL RESOLUTION (4 LOOKS)
- 0.5 sec INTEGRATION TIME PER CELL MEASUREMENT (PER LOOK)
- CELL SNR OF ≥5 dB OVER 100 km SWATH (4 LOOKS)

RESOLUTION CELLS



TECHNICAL CHARACTERISTICS

- CENTER FREQUENCY - 1274.8 GHz
- BANDWIDTH - 19 MHz
- TRANSMIT TIME/TOTAL TIME = 0.35
- PULSE WIDTH - 33.8 μsec
- CHIRP RATE - 0.562 MHz/μsec
- PULSE COMPRESSION RATIO (TIME BANDWIDTH PRODUCT) - 642
- EFFECTIVE PULSE WIDTH - 53 nsec
- PEAK TRANSMITTED POWER - 1125 W NOM
- PRF's - 1464, 1540, 1580, 1647 Pulses/sec
- AVERAGE TRANSMITTED POWER - 55 W

Figure E-5. **SAR technical summary**

from the surface target. Azimuth information was composed of the doppler shift history in the reflected signal from the surface in the direction of spacecraft motion. This information formed lines of constant doppler shift in the azimuth or cross-range direction. The intersection of the two bands of information yielded the surface elements shown.

Prime applications of the data are for wave directional spectra, coastal wave refraction analysis, and sea and lake ice dynamics. Because of the very high data rate (120×10^6 b/s), there was no onboard recording of data. As a consequence, earth coverage was limited to swaths approximately 4000-km long in regions adjacent to the five ground receiving stations. No SAR is scheduled to fly on NOSS.

Coastal Zone Color Scanner (CZCS)

The CZCS is an image scanner with six co-registered bands spectrally centered at 443, 520, 550, 670, 750 and 1150 nm (Figure E-6). The instrument utilizes a fully rotating scanner which scans across track at a rate of 8.0808 rev/sec. The Instantaneous Field-of-View (IFOV)

Performance Parameters	Channels					
	1	2	3	4	5	6
Scientific Observation	Chlorophyll Absorption	Chlorophyll Correlation	Yellow Stuff	Chlorophyll Absorption	Surface Vegetation	Surface Temperature
Center Wavelength (λ Nanometers)	443 (blue)	520 (green)	550 (yellow)	670 (red)	750 (far red)	1150 (infrared)
Spectral Bandwidth ($\Delta\lambda$ Nanometers)	433 - 453	510 - 530	540 - 560	660 - 680	700 - 800	1050 - 1250
Instantaneous Field of View (IFOV)	← .865 x .865 Milliradians (.825 x .825 km at sea level) →					
Co-registration at NADIR	< 0.15 Milliradians					
Accuracy of Viewing Position Information at NADIR	< 2.0 Milliradians					
Signal to Noise Ratio (min.) at Radiance Input N < (mW/cm^2 . STER . μm)	> 150 at 5.41	> 140 at 3.50	> 125 at 2.86	> 100 at 1.34	100 at 10.8	NETD of 0.220° k at 270° k
Consecutive Scan Overlap	25%					
Modulation Transfer Function (MTF)	1 at 150 km target size, 0.35 min. at 0.825 km target size					

Figure E-6. CZCS technical summary

is 0.05 deg, equating to a sea level square of 825 m on a side from the nominal orbital altitude of 955 km (Figure E-7). The active portion of the scan is 78.7 deg which produces a cross track swath of 1566 km. The scan rate and IFOV size are such that each swath overlaps the preceding swath by about 25 % .

The scanner mirror is capable of being tilted forward or backward ± 20 deg line of sight about the spacecraft pitch axis in 2.0 deg increments. This movement is commandable and is used to avoid sun glint while taking advantage of maximum solar elevation angles.

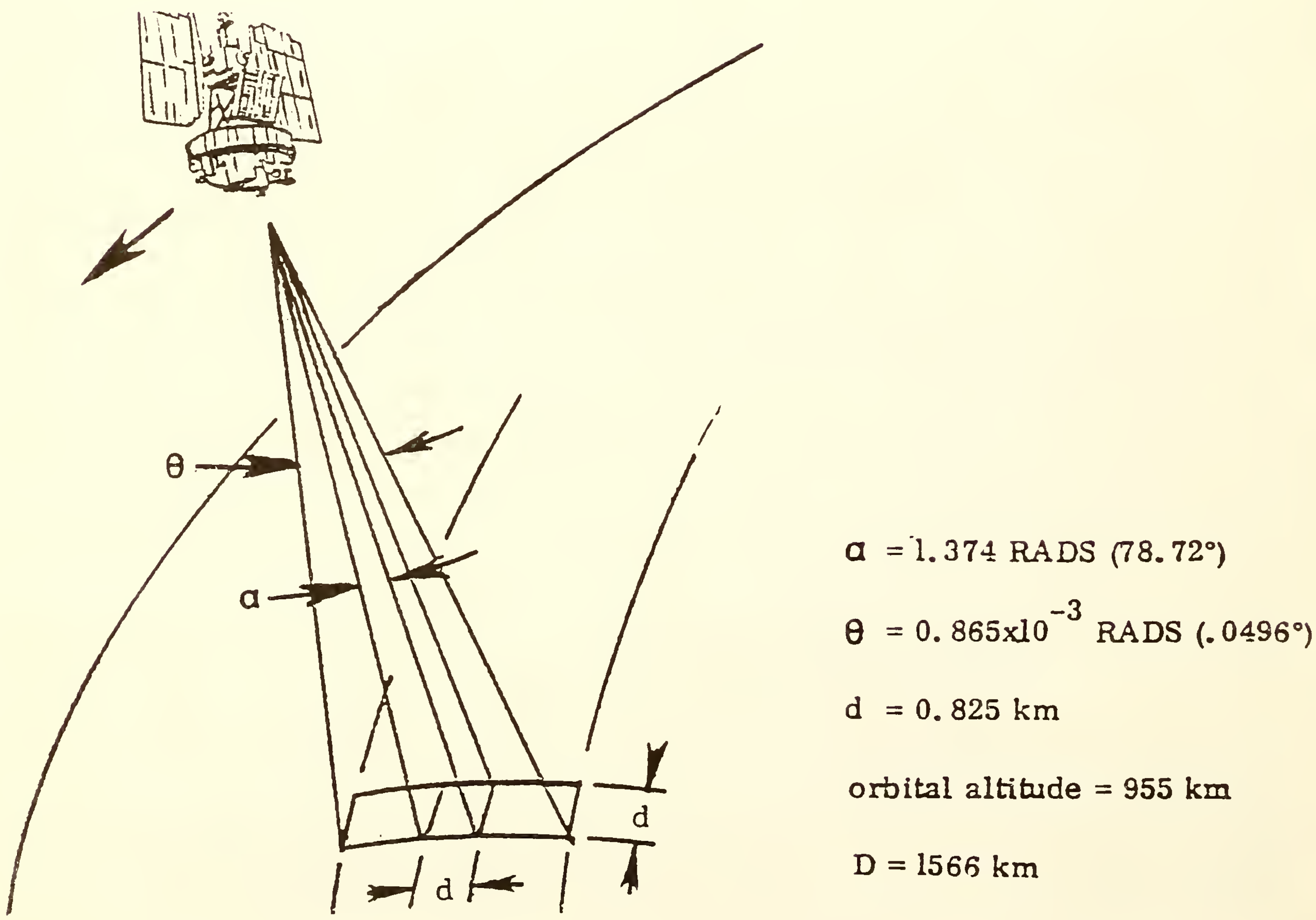
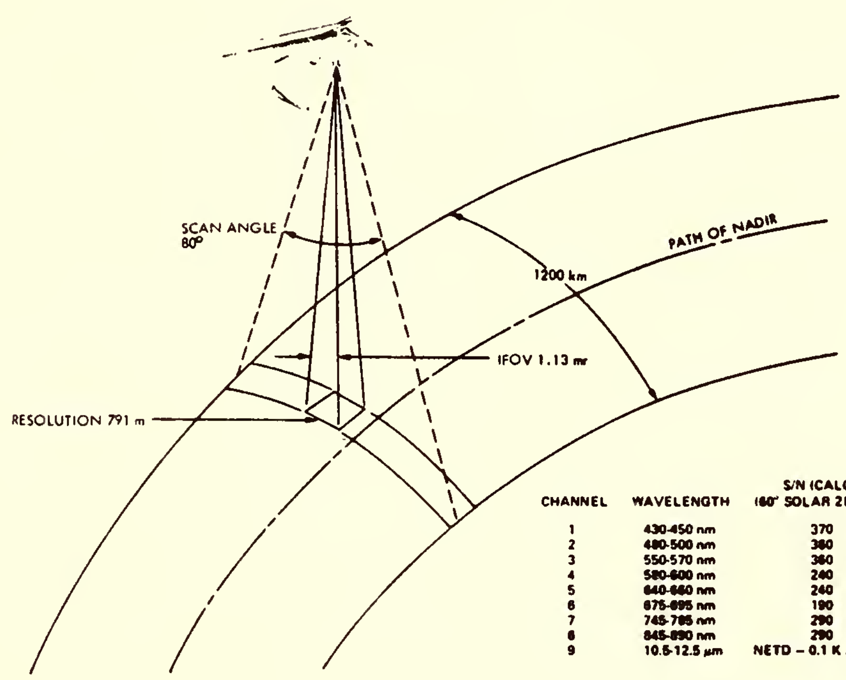


Figure E-7. CZCS geometry

APPENDIX F

NOSS BASELINE SENSOR DESCRIPTIONS

The characteristics of the four primary NOSS instruments determine, to a large extent, the design characteristics of their respective algorithms. Since the design of the hardware proceeds in parallel with the development of the algorithms, baseline instrument characteristics must be assumed for purposes of algorithm development. The assumed baseline descriptions which have been agreed to by NOSS Project Management are presented in Figures F-1 through F-4. The algorithm descriptions in this plan are based on these characteristics. Should subsequent instrument re-design change this information, the algorithm descriptions will be corrected in the next revision to this plan.



CHANNEL	WAVELENGTH	S/N (CALC.) (60° SOLAR ZENITH)
1	430-450 nm	370
2	480-500 nm	380
3	550-570 nm	380
4	580-600 nm	240
5	640-660 nm	240
6	675-695 nm	190
7	745-785 nm	290
8	845-890 nm	290
9	10.5-12.5 μm	NETD – 0.1 K AT 270 K

PERFORMANCE

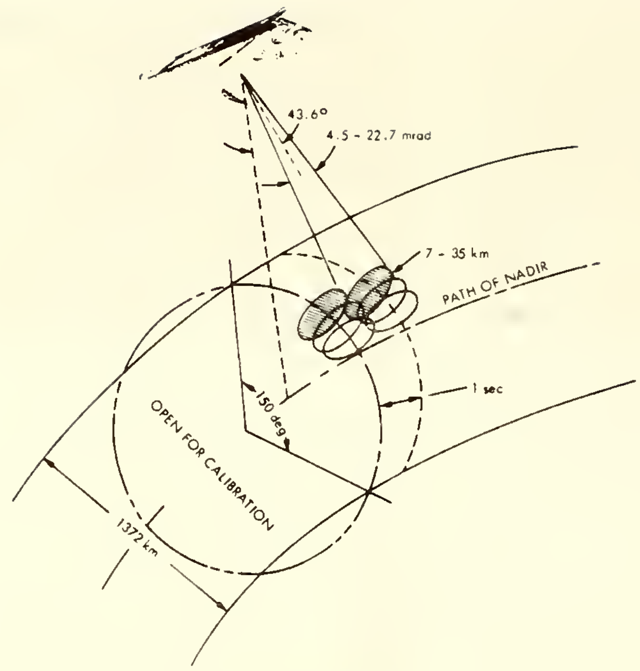
- PHYTOPLANKTON PIGMENT CONCENTRATIONS TO WITHIN A FACTOR OF 2
- DIFFUSE ATTENUATION COEFFICIENT (k) WITHIN A FACTOR OF 2
- SEA SURFACE TEMPERATURE ACCURATE TO APPROXIMATELY ± 2.0°C (0.2°C RELATIVE SENSITIVITY)
- RESOLUTION - APPROXIMATELY 800 m

TECHNICAL CHARACTERISTICS

- ORBITAL ALTITUDE: 700 k
- WEIGHT: 44 kgm
- DIMENSIONS: 85.4 × 40.9 × 55.6 cm^3
- POWER: 60.2W (AVG), 85W (PEAK) -28 V ± 0.3 V
- SCAN RATE: 8.52 Hz (510 rpm)
- DATA SCAN: ± 40° CROSS TRACK
- SCAN TILT ALONG TRACK: ± 20° IN 2° INCREMENTS: FULL EXCURSION EXECUTED IN < 1 min (i.e. +20° TO -20°)
- PIXEL SAMPLED PER SCAN (EACH CHANNEL): 1390
- CLOCK FREQ: 1.705 MHz

- IFOV: 1.13 mrad (VISIBLE AND IR)
- FOOTPRINT CONTIGUOUS AT NADIR: 798 m
- COOLER FIELD-OF-VIEW: 101° SOLID ANGLE
- MAXIMUM DATA RATE: 4.8 × 10^6 b/s
- BUFFERED DATA RATE: 1.13 × 10^6 b/s
- SAMPLING RATE (1.12 IFOV): 53.3 SAMPLES/SECOND
- SAMPLING RESOLUTION (DIGITIZATION): 10 BITS (PER CHANNEL)
- DIAMETER OF OPTICAL APERTURE: 17.8 cm

Figure F-1. CZCS II baseline description



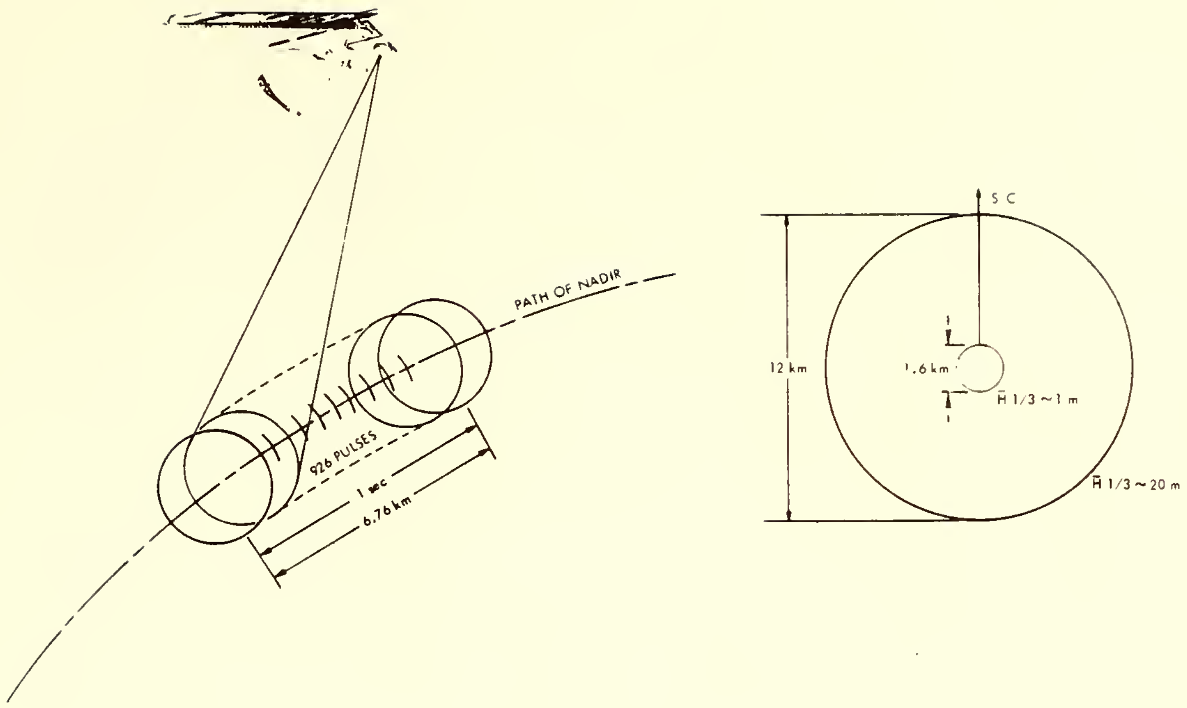
PERFORMANCE

- SEA SURFACE TEMPERATURE ACCURATE TO WITHIN ±1.5 K AT 25 km RESOLUTION
- WIND SPEED 0–50 m/s, ACCURATE TO WITHIN ± 2 m/s OR 10%, WHICHEVER IS GREATER AT 17 km RESOLUTION
- SEA ICE CONCENTRATION TO WITHIN ±15% AT 9 km RESOLUTION
    - TYPE CLASSIFICATION - NEW, FIRST-YEAR, MULTI-YEAR
    - AGE - INFERRED THICKNESS TO WITHIN ± 2 m
- ATMOSPHERIC WATER VAPOR TO WITHIN ±0.2 g/cm^2 AT 9 km RESOLUTION

TECHNICAL CHARACTERISTICS

• ORBITAL ALTITUDE	700 km						
• WEIGHT	320 kg						
• DIGITIZATION	12 bits						
• DATA RATE	64 kb/s						
• POWER (NOMINAL-AVERAGE)	350 W (NOMINAL AVERAGE)						
• FREQUENCY (GHz)	4.3	5.1	6.6	10.65	18.7	21.3	36.5
• WAVELENGTH (cm)	7.0	5.9	4.5	2.8	1.6	1.4	0.8
• ANTENNA APERTURE	← 4.0 m →						
• POLARIZATION	← HORIZONTAL AND VERTICAL →						
• CROSS-POLARIZATION ISOLATION	← 17 dB (MINIMUM) →						
• 3 dB BEAMWIDTH (deg)	1.3	1.1	0.9	0.6	0.3	0.26	0.26
• BEAM EFFICIENCY	← 90% (MINIMUM) →						
• EFFECTIVE SENSITIVITY T_B (K) (AVG VALUE)	0.2	0.3	0.4	1.0	1.5	1.5	1.5
• CALIBRATION PRECISION (K) (AVG VALUE)	0.5	0.5	1.0	1.0	1.5	1.5	1.5
• SCAN NADIR ANGLE	← 43.6° →						
• VIEWING ZENITH INCIDENCE ANGLE	← 50.0° →						
• 3-AXIS VIEWING ANGLE KNOWLEDGE	← 1/3 BEAMWIDTH →						
• FOOTPRINT (km x km)	23x36	20x31	16x25	11x17	5x8	5x7	5x7
• SCAN RATE	← 60 rpm →						
• ACTIVE SCAN ARC (FORWARD)	← 150° →						
• SWATH WIDTH (150° SCAN)	← 1372 km →						
• IFOVs SAMPLED PER SCAN (EACH CHANNEL)	← 256 →				← 512 →		

Figure F-2. LAMMR baseline description



PERFORMANCE

- REAL TIME ONE SECOND SIGNIFICANT WAVEHEIGHT (H 1/3) MEASUREMENT ACCURACY - ±0.5 m OR 10% WHICHEVER IS GREATER FOR H 1/3 FROM 1 TO 20 m
- SIXTY-EIGHT PERCENT (1σ) OF ONE SECOND ALTITUDE MEASUREMENTS TO LIE WITHIN ±10 cm OF THE FITTED MEAN
- BACKSCATTER MEASUREMENT PRECISION WITHIN ±0.5 dB FOR WIND SPEED DETERMINATION

TECHNICAL CHARACTERISTICS

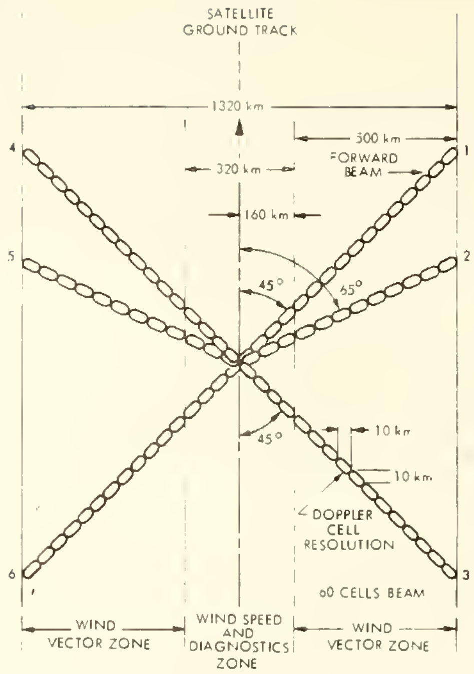
• ORBITAL ALTITUDE	700 km
• TWO ALTIMETERS (REDUNDANT FOR 3-YEAR TOTAL DESIGN LIFE)	
• FREQUENCY	13.56 GHz
• PULSE WIDTH (UNCOMPRESSED)	3.2 μs
• TRANSMIT TIME ÷ TOTAL TIME	3.3×10^{-3}
• PULSE REPETITION RATE	926 Hz
• COMPRESSED PULSE WIDTH*	3.125, 6.25, 12.5, 25, 50 ns
• CHIRP RATE*	100, 50, 25, 12.5, 6.25 MHz/μs
• ADAPTIVE BANDWIDTH*	20, 40, 80, 160, 320 MHz
• ANTENNA BEAMWIDTH	1.6°
• ANTENNA POLARIZATION	LINEAR
• ANTENNA GAIN	40.8 dB
• SYSTEM NOISE TEMP. FIGURE	11 dB
• RECEIVER GAIN	95 dB
• RECEIVER DYNAMIC RANGE	63 dB
• RECEIVER POWER RANGES	-85 TO -22 dBm

• FOOTPRINT DIAMETER	
• BEAM LIMITED	20 km
• PULSE LIMITED (H 1/3 ≈ 1 m)	1.6 km
• PULSE LIMITED (H 1/3 ≈ 20 m)	12 km
• RANGE GATES	
• FOR PULSE FORM DEFINITION	63 ea
• FOR RAIN GATE	2 ea**
• OUTPUT DATA RATE	20 kb/s
• DIMENSIONS (EACH ALTIMETER)	
• SIGNAL PROCESSOR	34 × 51 × 25 cm
• ANTENNA AND rf SECTION	100 × 80 cm
• WEIGHT (EACH ALTIMETER)	100 kg
• AVERAGE POWER (EACH ALT)	
• STANDBY POWER	102 W
• OPERATING	177 W
• PEAK rf TRANSMIT POWER	2 kW
• AVERAGE rf TRANSMIT POWER	6.5 W

*THE FIVE LEVEL ADAPTIVE RESOLUTION IS TENTATIVELY INCLUDED PENDING COST AND ENGINEERING IMPACT DETERMINATION

**UNDER STUDY

Figure F-3. ALT baseline description



PERFORMANCE

- OCEAN SURFACE WIND SPEED 4 TO 24 m/s, ACCURATE TO WITHIN ±2 m/s OR 10%, WHICHEVER IS GREATER
- OCEAN SURFACE WIND DIRECTION 0-360°, ACCURATE TO WITHIN ±20° AND WITH DIRECTIONAL AMBIGUITY 66% CORRECT
- WIND VECTOR GRID SPACING - 50 km (GLOBAL), 25 km (REGIONAL)

TECHNICAL CHARACTERISTICS

• ORBITAL ATTITUDE	700 km
• SWATH WIDTH	1320 km
• GRID SPACING σ^0	10 km
• CELL RESOLUTION σ^0	10 km × 10 km (EQUIVALENT
• CELL RESOLUTION (WIND VECTOR, LEVEL II)	
• GLOBAL AT FULL PRECISION	50 km × 50 km
• REGIONAL AT REDUCED PRECISION	25 km × 25 km
• FREQUENCY	13.99 GHz
• BANDWIDTH	±500 kHz
• ANTENNA POLARIZATION	HORIZ VERTICAL
• ANTENNA PEAK GAIN	32.5 dB
• BEAMWIDTH	$2^\circ \times 25^\circ$
• MEASUREMENT SAMPLING PERIOD FOR EACH ANTENNA	0.25 s
• DIGITIZATION	12 bits
• DATA RATE	20 kb/s
• TRANSMIT TIME ÷ TOTAL TIME	0.21
• PULSE WIDTH	5.0 ms
• PULSE REPETITION RATE	42 pulses/s
• AVERAGE TRANSMITTED POWER	21 W
• PEAK TRANSMITTED POWER	100 W
• RECEIVER NOISE TEMPERATURE	770 K
• GAIN CONTROL	AUTOMATIC
• MAXIMUM BIAS ERROR	≤ ± 2 dB
• SYSTEM PRECISION	±0.1 dB
• ELECTRONIC SYSTEMS (2)	SIMULTANEOUS OPERATION (3 ANTENNAS EACH SYSTEM) WITH DUAL POLARIZATION
• WEIGHT	240 kg
• POWER	260 W REGULATED 170 W UNREGULATED
• DIMENSIONS	
• ANTENNAS	310 × 10 × 15 cm (EACH)
• ELECTRONICS	115 × 55 × 31 cm (EACH)
• EFFECTIVE INTEGRATION PERIOD FOR 10 km × 10 km RESOLUTION CELL	~40 ms

BACKSCATTER & RECEIVED SIGNAL

BACKSCATTER, dB

WIND m/s	ANGLE 25° V	25° H	55° V	55° H
4	-14	-13.6	-37.5	-43.0
24	-3.0	-3.6	-14.8	-19.5
48	1.2	35	-6.0	-10.3

RECEIVED SIGNAL, dBm

WIND m/s	ANGLE 25° V	25° H	55° V	55° H
4	TBD	TBD	TBD	TBD
24	-	-	-	-
48	-	-	-	-

Figure F-4. SCATT baseline description

APPENDIX G

GLOSSARY OF ACRONYMS & ABBREVIATIONS

AOML	Atlantic Oceanographic and Meteorological Laboratory
APT	Automatic Picture Transmission
ATS	Applications Technology Satellites
AVHRR	Advanced Very High Resolution Radiometer
CEAS	Center for Environmental Assessment Services
CCT	Computer Compatible Tapes
CZCS	Coastal Zone Color Scanner
DOC	Department of Commerce
DOD	Department of Defense
DOMSAT	Domestic Communication Satellite System
EDIS	Environmental Data and Information Service
EROS	Earth Resources Observational System
ESIC	Environmental Science Information Center
ESSA	Environmental Science Services Administration (Predecessor to NOAA)
FACA	Federal Advisory Committee Act
GEM-10b	A geoid model
GEOS	Geodynamics Experimental Oceanographic Satellite (NASA)
GMT	Greenwich Mean Time
GOES	Geostationary Operational Environmental Satellite (NOAA)
GOSSTCOMP	Global Operational Sea Surface Temperature Computation
GSA	General Services Administration
HRPT	High Resolution Picture Transmission
IFOV	Instantaneous Field of View
IR	Infrared
ITOS	Improved TIROS Operational Satellite
JPL	Jet Propulsion Laboratory
LAMMR	Large Antenna Multichannel Microwave Radiometer
LANDSAT	Land Observing Satellite (NASA)
MTS	Marine Technology Society
NAFAX	National Facsimile Network
NASA	National Aeronautics and Space Administration
NEFC	Northeast Fisheries Center
NESS	National Environmental Satellite Service
NIMBUS	Atmospheric and Oceanic Observing Satellite (NASA)
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NODS	NOAA Oceanic Data System
NOS	National Ocean Survey

NOSS	National Oceanic Satellite System
NSTL	National Space Technology Laboratories
NWFC	Northwest Fisheries Center
NWS	National Weather Service
PMEL	Pacific Marine Environmental Laboratory
QEII	Queen Elizabeth II
R&D	Research and Development
SAR	Synthetic Aperture Radar
SASS	Seasat Scatterometer System
SEASAT	Oceanic Observing Satellite (NASA)
SDSD	Satellite Data Services Division
SEFC	Southeast Fisheries Center
SIO	Scripps Institute of Oceanography
SMMR	Scanning Multichannel Microwave Radiometer
SMS	Synchronous Meteorological Satellites
SOSU	Seattle's Ocean Services Unit
SST	Sea Surface Temperature
SWFC	Southwest Fisheries Center
TDRSS	Tracking and Data Relay Satellite System
TIROS	Television and Infrared Observation Satellite (NASA/NOAA)
USGS	United States Geological Survey
VHRR	Very High Resolution Radiometer
VIRR	Visible and Infrared Radiometer
VISSR	Visible Infrared Spin Scan Radiometer
WEFAX	Weather Facsimile
WHOI	Woods Hole Oceanographic Institute
WSFO	Weather Service Forecast Office
WWB	World Weather Building
XBT	Expendable Bathythermography

APPENDIX H

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